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Remove Not the Ancient Landmarks

FAILURE to uphold the traditions of an industry, especially if they constitute the foundation on which the success of the industry depends, can lead to but one result—disaster. This is a truism generally recognized throughout the central-station industry and manfully lived up to by the industry in this time of great distress and uncertainty. One public utility, as the nation well knows, has been remiss in its duties, and its experience may serve as an object lesson to central stations. Railroad congestion has been laid at the door of the railroad officials by the president of the Brotherhood of Railroad Trainmen, who maintains that if the railroad companies had directed their efforts toward getting trains over the roads there would not have been any such congestion as is in effect now on all of the railroads and particularly at the Eastern terminals. There is one part of his statement, however, which overtops all the rest, and this should serve as a beacon to warn other utilities of the rocks and shoals which might wreck them. Indifference of the railroad operating heads, coupled with an apparent desire to teach the public an object lesson concerning the need for increased rates, had been noticed by seasoned railroad employees for months, according to their leader, and the general opinion prevails among them that the object lesson which the railroads attempted to teach got beyond their control. Whether or not this is a fair statement of the case we do not presume to say, but if it represents the mature opinion of old railroad employees it is a severe arraignment. It also brings into bold relief the fact that if in slighting service the purpose was to show the necessity of increased rates the railroads were playing with fire. The lesson which this situation brings home to the central-station industry is immediately apparent. We do not believe that electric utilities contemplate detracting by one iota from their tradition of excellent service. To do so would be suicidal. But if there be any who contemplate such a move we commend to their prayerful consideration the plight of the railroads.

Planning for Wider Markets After the War

WHILE we must ever keep in the forefront the vital necessity of winning this war, we ought not to be unmindful of the day when nations shall beat their swords into plowshares and their spears into pruning hooks. To short-sightedness and unpreparedness we owe much of our present muddle. We have had object lessons enough; shall we employ them to our profit and the nation's gain? If our wheels of industry are to be kept turning after peace is declared, we shall need a fair share of the world's trade. This is as patent as it is potent. Ships we will have, and American manufacturers should see to it that they shall have the markets and freight to keep these ships always on the high seas. Germany, the arch enemy, somehow finds money and time to plan for business conquests. England, despite her enormous war burdens, retains her grip on foreign markets. The Scandinavians and Dutch ply their overseas trade assiduously, and shall we be found wanting in the crucial commercial test of coming world-wide competition? We are enormous producers and also users of electrical equipment, but we also need to spread the gospel of electricity to other lands. It is a duty we owe to civilization. It is also an obligation we owe to our industry. If we are to succeed, plans must be made at once, for the task is not easy, although the reward is great. Moreover, the plan need not and should not interfere with the successful prosecution of the war. England has established an intelligence system to supply her industries with trade information from all parts of the world. We should do likewise.

Calibration of Power-Factor Meters by Direct-Current Methods

THE polyphase power-factor meter of switchboard type is an instrument designed to indicate the instantaneous power factor of the polyphase system to which it is connected. As ordinarily constructed, its series coil is connected in one line only of the system, and its indications are only to be regarded as correct so long as the system remains balanced. A considerable degree of unbalancing is likely to affect prejudicially the accuracy of the indication.

When such an instrument is assembled and brought to the testing table for either calibration or check, there is usually no difficulty in providing a non-inductive resistance load for the 100 per cent indication, so that this point on the scale is readily determinable. When, however, some other definite point on the scale, such as the 80 per cent point, has to be checked, it is not so easy to provide the load of just this power factor, so that a good deal of adjustment and computation may be needed to bring about the right condition.

An ingenious method for making the calibration test for a well-known type of power-factor meter, using direct currents, is described this week by T. W. Varley. The direct-current strengths in the two movable coils are adjusted according to a definite schedule, so as to provide the same deflecting torque as the corresponding

phase relations in the normal use of the instrument with alternating-current supply. The technique of the calibration should therefore be made relatively very simple and definite, provided that the construction of the dynamometer is such as will produce the proper phase relations of design in alternating-current use.

The English Power Supply Situation

A REPORT recently published in England of the coal conservation sub-committee of the reconstruction committee sets forth in unmistakable terms the reforms necessary in power generation and distribution if the full advantage of electric supply is to be realized. The situation in England is different only in degree from that which exists here, and hence the conclusions of the committee may be taken seriously to heart. In the United States there have grown up a number of great hydroelectric networks which are very important sources of power supply. There have also been organized central-station enterprises on an unprecedented scale which do within areas as yet somewhat limited and with steam as the chief motive power much the same valuable work that the hydroelectric systems can accomplish. But, admirable as all this is, much more remains to be accomplished. The hydroelectric systems need to be developed still further. They must take in all the available water powers within the area covered, including those on the public domain which we hope will soon become available, and must make their distributions so complete and far-reaching that there shall be small excuse for fuel consumption within the areas served. The great steam-supplied systems must go on, as they are now indeed doing, to bigger things, to the building of what the British committee calls superstations, to the abandonment of those which are inefficient, to the consumption of coal when possible at the mine's mouth, and to the more complete development of their service so that no small and inefficient plant shall find economic opportunity for existence.

The British situation as disclosed in this report is in some respects a very unfortunate one. The total supply is divided, despite the modest area involved, between some 600 independent private and public undertakings having an average capacity in power stations of only about 5000 hp., hardly a quarter of that which can well be utilized in a single generating unit. The situation has been rendered more difficult by the large number of municipal plants, some of them very well handled within their limitations, but organized without sufficient reference to the securing of good conditions of generation. There has been an unhappy tendency, brought about by municipal enterprise, toward building plants in most unsuitable places merely to get them within the jurisdiction of the respective municipal authorities. The result has been that not a few large plants, supplying cities of several hundreds of thousands of inhabitants and large industrial needs, have been located where there is no proper supply of water for condensing purposes and have been driven to the use of cooling towers. The large number of municipal enterprises has hampered the development of those under private management, thus still further complicating a bad situation. The unification of existing systems is no easy matter, for the local plants vary greatly in character, distribution voltage, facilities for linkage with distribution lines, and, even when these exist, in the fundamental matter of frequency. There is in Great Britain little such tendency toward standardization of frequency as is found in this country, no less than ten frequencies actually being in use in the British plants.

It has been repeatedly proposed in England that bodies should be created to deal with bulk supply upon which the existing undertakings would draw for anything beyond their present capacity. This is a step in the right direction, but the tendency for local bodies to cling to their pet stations will stand in the way of rapid reform, and unless existing stations could be operated on a comprehensive plan they would not even be of much use for standby and peak-load service. In other words, for gaining the advantages of bulk supply common control is a fundamental necessity. The logical answer to the grave economic questions involved is the organization of a unified power system at least for each industrial district, probably ultimately with interconnection over the whole of England. The recommendations of the committee are that there should be a single authority for each of the districts, of which a tentative distribution of interests would indicate sixteen, each controlling a single plant. These plants should be placed on important waterways, on ample sites and with good transport facilities. Furthermore, these sites should be large enough to allow the installation of by-product plants to secure the salvage of valuable material from the coal and to accommodate the electrochemical industries which year by year will require a larger and larger supply of cheap power. Here the "super-power" plants should be erected, with units of not less than 20,000 hp. and very likely up to 50,000 hp. These great stations would ultimately take over the whole electric supply in their respective districts.

To the end that some progress may at once be made the committee recommends the appointment of a board of electricity commissioners with full powers to deal with the electricity supply situation throughout the country and authorized to stop the extension or multiplication of uneconomical stations; to arrange for taking over the generation, transmission and main distribution system in each of the districts, putting it in charge of a new district body; to standardize for each district frequency and voltage, and to settle for each district what form of undertaking should be charged with the actual administration of the work. This is a large and serious program, not to be carried out without many difficulties of detail. There is one fortunate circumstance in the situation, however, in that there is one authority—to wit, Parliament—which stands supreme in administration. Many minor questions will have to be settled by cautious deliberation over all the circumstances, but the fundamental proposition is thoroughly sound. If carried out, the committee estimates that the saving in fuel alone would be more than 50,000,000 tons per annum based on the present usage of power. This quantity must rapidly increase as industrial development goes on after the war is over, and it is well that the problem is being now taken earnestly in hand. We in this country may well heed the lesson of this preliminary investigation, for much as we have done we have as yet gone but a little way toward the general distribution of power on a scale commensurate with the needs of the future.

Blower and Compressor Service

ANOTHER of Professor Clewell's useful papers appeared in the last issue, giving some of the characteristics of the power requirements of fans and other devices for producing movement of air. Apparatus of this kind varies very radically in type with the service to which it is applied. The actual characteristics of the service vary enormously with the requirements to be met. Ordinary fans of the type familiar to every one have for their special function the movement of a large bulk of air at relatively very low pressure. For moderate pressure blowers of the familiar centrifugal type are commonly used, and for high pressures the two-stage or three-stage units built along the general lines of the reciprocating steam engine. It is to the first two classes of apparatus that Mr. Clewell has particularly directed attention. All such apparatus has one common characteristic in that the power required varies rapidly with the speed, practically as the cube of the speed for a given area of discharge opening. Consequently the starting torque is very slight, which separates blower service from almost every other variety of motor drive. The efficiency of the apparatus does not vary to any material extent with variations in speed, again an almost unique characteristic. The light starting torque greatly simplifies the equipment of motors and lessens the severity of their sudden requirement for power at the moment of starting.

Almost any sort of motor is, therefore, available for blower service, and in particular single-phase alternating-current motors, often looked at askance on account of their low torque at starting, serve admirably in operating fans and blowers. Induction motors of the simplest kind are entirely adequate for this service. When the supply is direct-current either shunt or series motors may be used, the former being generally preferable. The control of fan and blower motors is obviously a very simple matter, the smaller sizes requiring nothing more than a connecting switch. Large machines should have at least a starting rheostat and now and then under exceptional conditions an overload release. Only in high-duty compressors is there special call for any elaboration of the starting equipment, such as is common with other motors. As the speeds required for rotating blowers of every sort are rather high, direct connection of the motor is very often practicable, although the best speed of fan may not agree well with the quasi-synchoronous speeds of alternating-current motors. Large blowers should generally be planned for direct connection, while belting is very often convenient in the smaller sizes. It is perfectly practicable to use either method, and either can be made silent, an important characteristic in much ventilating work. Belted machines have some advantage in this respect when the fan speed is relatively low. It takes a good deal of finesse on the part of the designer to secure a silent fan of respectably large output and advantageous speed, but the trick can be turned successfully. It must be seen that the requirements for fan and blower motors are easy, but rather highly specialized, and Professor Clewell's article gave a very comprehensive view of the general conditions which must be met.

Simplifying Transmission-Line Calculations

IT IS now well recognized that in the theory of the transmission of electrical energy over wires of any length, whether they are merely carried across a street or whether they are carried across a continent, the fact that the resistance, inductance, capacitance and leakance of the wires is ordinarily distributed with reasonable uniformity causes the impedance, voltage, current and power at any point along the line to be proportional to simple functions of a certain hyperbolic angle which applies to that point. The magnitude of this angle depends not only upon the frequency of the alternating current supplied to the line but also on the load or loads which may be applied at the motor station or stations. For the low-frequency power transmission and distribution the hyperbolic theory has very little practical importance unless the line is very long and the ordinary Ohm's law computations are nearly enough applicable for practical purposes. At telephonic frequencies, however, lines of ordinary length have to be treated in theory by the use of hyperbolic functions, if the numerical results are to remain simple and easily obtained. At the very high frequencies of radio operation even the shortest lengths of line come under the natural dominion of these functions.

The article in this issue by T. A. Wilkinson on "Simplifying Transmission-Line Calculations" presents certain diagrams in an "exponent chart," with the aid of which the computation of the voltage and current along the transmission line may be determined with ordinary tables. The method employed differs in interesting details from those which have thus far been presented. The relative advantages of the different methods for arriving at an assigned set of required results are always a matter for discussion. The method presented by Mr. Wilkinson is applicable to determining the electrical conditions at any point along the power-transmission line. If, however, only the conditions at the two ends of such a line are desired, it seems likely that the computation of the equivalent π of the line would be swifter. It would be interesting to have comparisons presented as to the brevity of the various methods now known for determining the electrical working conditions of a given long line at a known terminal load and a known frequency.

The Coming Issues

COILS of wire are used for so many purposes in electrical engineering applications that H. B. Dwight's article on the self-inductance of long coils, which will appear in the next issue of the ELECTRICAL WORLD, should be of interest to many readers. The writer develops a formula which is very simple to apply. Another feature of the Feb. 9 issue will be an article on a bulk-supply generating station situated at the mouth of a coal mine and operated jointly by two electric service companies. Arrangements which have been made to make joint operation successful will be outlined and particular attention will be directed to the mechanical features of the plant. Other articles which will appeal to different types of engineers will also be presented next week.

Rate Increases to Follow High Cost of Coal

Prospect of Permanent Higher Level of Fuel Cost Leads Companies to Plan Ahead So That Advances in Rates May Offset Increase in Production Expense—Other Factors in the Outlook

THE final outcome of tremendous coal demand upon the market price of that commodity has a direct bearing upon rates of electric central stations. As shown in the ELECTRICAL WORLD, many companies have advanced rates to reimburse themselves in part at least for increased coal cost. They asked the consumer to share the heavier operating expense. In some cases the feeling of executive officials has been that acute coal conditions were temporary and that when they became normal again electric rates could be restored to their former level. This is in part the theory underlying the coal clause which has been introduced by many properties to raise or lower rates automatically with increases or decreases in coal cost. This general idea that coal conditions were temporary has led certain companies to refrain from advancing rates.

In many properties, however, and particularly the small stations which have limited business and earnings and limited possibilities for expansion, the burden of coal cost is too heavy to be taken into the accounts without an increase corresponding in some degree in rates. These properties lack the diversity of business of the large systems and they are without reserves to withstand a sharp enlargement of operating expense; unless they can definitely transfer such expenditures as those the industry faces for coal they are compelled to write red-ink balances in their accounts or show a reduced surplus.

WHAT OF THE FUTURE?

Beyond the immediate meaning of higher coal cost and the higher rates established in a large number of cities throughout the country is the question of what the future holds. Most companies reached in the ELECTRICAL WORLD canvass are of the opinion that the great upheaval in coal conditions will cause a permanently higher price level for that necessary commodity. The steam central stations relying on coal for fuel are not alone in this conclusion; it is held also by companies using other forms of fuel in whole or in part, such as crude oil or natural gas. From this premise the conclusion of many companies is that future electric rates will undoubtedly be higher. Against this there is, of course, the possibility of more efficient generating apparatus and practices, but that raises also the question of the economic desirability under existing conditions of scrapping existing plants to provide for the possible new inventions. It brings up the question of financing expenditures of this nature, which is serious at this time and will probably so continue.

"The coal situation," writes one general manager in a statement which effectively presents the views of many companies, "in my opinion is going to affect operating conditions, rates, etc., for a material time. Even though the war should cease to-morrow, the era of low prices for coal and labor is past for some time to come. The result is going to be greater operating costs and a necessity for the increase of rates to match those costs. Coal and labor are not going to be the only determining factors in this matter, as I feel it will take a considerable time for all of the other forms of material which we use in our work to return to anything comparable in price with that which prevailed before July 1, 1914."

The following opinions also point to future higher rates:

We are of the opinion that operating expenses of all utilities will be seriously affected in the future by the price of coal, and that the only answer is to proportionately advance the rates.

In our opinion, unless central stations get some relief by being allowed to increase their rates, they will be in very serious financial condition before the end of 1918. The advance in cost of coal has been tremendous. Where there is not a state regulatory body the federal government should give the companies relief by allowing rate increases. Many companies believe these results should come indirectly through the state and federal fuel administrators.

We believe that the coal situation will necessitate substantial rate increases of a temporary nature and that all rates will have to carry some permanent increase. We believe that the central-station operators will be able to effect these increases with comparative ease and also without running risk.

It would seem to us that while the government is endeavoring to control the fuel situation and since it continues to increase the price that we are compelled to pay, it should also authorize the state public utility commissions to grant temporary increases to all utility companies in the form of a surcharge or war tax, until such time as appraisals and hearings could be had in each case, when final adjustment could be made.

We are arranging to ask for an increase in all of our rates, based on the increased cost of production. The outlook for the winter is serious. Being located in the midst of a number of mines, our plant is especially well supplied with coal, but if the government continues to increase the price, as it has been doing, we do not know where we will land.

One manager, feeling that it is difficult to forecast the future coal situation, is "more or less of the opinion that after the severe strain has passed coal prices will necessarily drop, but under the present tension it will be necessary for many plants to increase their rates, either temporarily or permanently, in order to take care of increased cost."

Two companies cite the need of making rates high enough to give a return attractive to capital:

The price of coal affects our conditions so seriously that radical changes in all rates will be necessary if the company is to live and expand. No new money can be obtained for extensions or improvements at this time.

In the indefinite future, operating expenses will be much higher, and rates must be increased proportionately if good service is to be given the public and the necessary and proper rate of return on investment obtained, so that the necessary new capital can be secured.

The probable necessity of reducing maintenance outlay as well as of increasing rates is seen by one executive:

"Owing to increased costs of coal, it will be necessary to reduce other costs," he writes, "with probably a reduction in maintenance and a general advance in rates. In the long run the former can be brought back to normal, but the higher rate charges will probably stand for a considerable period until the entire country reaches the general readjustment period after the war."

Closely allied to this thought is the expression of opinion of another manager, who urges the "most economical use of the plant and proper rates."

Similar suggestions, bearing on increased efficiency and economies, follow:

The cost of coal will increase our operating cost in the future. However, this increased cost of fuel will be somewhat offset by the increase in efficiency which will be sure to come with higher-priced coal.

Central stations will simply have to raise the price of their service to consumers in order to meet the increased cost of fuel. Conditions no doubt will be abnormal during the war and for some time after the war. Central stations must meet these conditions with economies, increases in rates and otherwise, quickly changing operating methods, rates, etc., to keep pace with the times.

Development of more economical production methods is the only alternative to a permanent increase in rates in the judgment of one company: "It is our opinion that the price of coal will never decrease as much as it has increased and that in the future coal will remain much higher than it has been in the past, and that rates for electricity will be permanently increased to some extent, unless cheaper methods of production can be obtained."

A general manager, whose great difficulties with shortage make him feel that the fuel outlook for the entire present winter is very gloomy, expresses the hope that the lessons which the country is learning will turn the negligent national water-power policy into positive action. He writes:

There can be only one effect on operating conditions, rates, etc., in the future—that of increased rates for service rendered. This condition emphasizes the need for legislation by our national government providing for the development of water powers. In many instances the development of the water powers throughout the country will control the flow of erratic streams and thereby reclaim hundreds of thousands of acres of the best farming lands in our country. It is quite evident that our government should aid in the development of these streams, as by so doing capital will be attracted for financing these developments and a long step be taken toward the conservation of our fuel resources.

A president, who believes that many companies cannot continue to operate under present trying conditions, suggests that "a reduction in the number of cars operated by the electric railways is the best solution for reducing expenses and conserving the coal supply."

It is admitted without contradiction that the crisis in the coal situation has given the fine economy of the central station a new prominence. It has given greater recognition to the advantage of large-scale production as a powerful influence in the conservation of coal. Therefore the companies, looking even beyond the widespread acceptance of the economy of the central station as contrasted with the less efficient isolated plant, anticipate still further development of the large producing and distributing units. Significant of the outlook in this direction are the following:

I don't think the price of coal will ever return to the old level, consequently, all utility operating ratios are going to reach a higher average. The net possibly can be increased over former years by the increased volume of business. As all other fuel-using industries are affected by the high cost of fuel, it is going to be easier for the central station to obtain power contracts than heretofore. This will mean the building of larger and more economical plants by the central-station people, and in the end I believe the utilities will be better off.

The present coal situation and the indicated coal situation for the duration of the war is bound to increase the demands upon central stations and upon hydroelectric plants to the extent of capacity of the central stations. They can be loaded up and with proper management can retain the load thus obtained, adding to their capacity later on when prices for machinery are more normal, thereby much more cheaply and quickly increasing the available capacity for generation of electrical power and being able to supply it with much smaller consumption of coal than is possible with isolated plants.

THE WINTER'S PROSPECTS

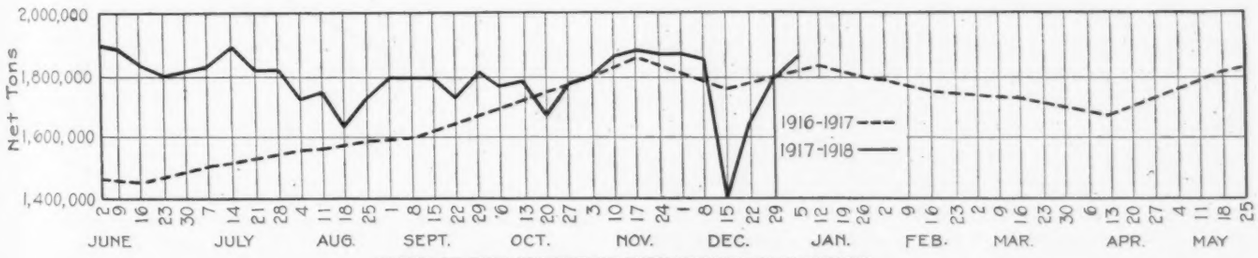
The prospects for adequate coal supply in the present winter continue to be very precarious, and companies express grave apprehension. Curtailment of activity through the Garfield suspension days will give slight temporary relief. The following expressions of opinion deal with the general conditions of the current winter and do not take into account the Garfield days:

The outlook for 1917-18 was fairly good for our coal supply until the advent of the cold spell during the last eight days and the consequent demoralization of the railroads. Unless some vigorous steps are taken to stop the accumulation of coal at railroad junctions and terminal points, we can expect to have serious trouble, as, from what information I can gather, the trouble is in the transportation. The railroads cannot handle the traffic and consequently cannot deliver empties to the mines. Pooling will probably greatly relieve the situation.

The outlook for the winter of 1917 and 1918 is anything but pleasant. I do not know what we will do unless central stations have priority of coal.

In our judgment, the outlook is far from encouraging; in fact, we feel that the outlook is a very serious one.

[A continuation of this article to be published next week will deal with other vital phases of the critical coal situation.]



STORY OF THE OUTPUT OF BITUMINOUS COAL MINES

Electrical Features of Joliet (Ill.) Station

Concluding Installment of Article Regarding the High-Pressure Steam Plant of Public Service Company of Northern Illinois—List of the Most Important Equipment

GENERAL and mechanical features of the new high-pressure steam station of the Public Service Company of Northern Illinois were discussed in the issues of the ELECTRICAL WORLD for Jan. 19 and 26. This concluding section will dwell on the electrical features.

In the electrical end of the station there are no radical departures from standard practice like those in the steam end, but the design is interesting nevertheless as representing a studied selection and arrangement of apparatus to give the most efficient and economical operation under the conditions. The fact is that the high economies of the station as a whole will open up a new field for the sale of energy. Many industries which could not be economically served before will now find their own electricity-producing equipment so far inferior in economy to central-station service that it will pay them to buy power. It was the desire to provide for this condition that made the engineers provide for a number of feeders leaving the station at the generator voltage. Just how the ultimate installation of feeders will be divided between 12,000-volt and 33,000-volt is not yet definitely decided. The station is laid out for considerable flexibility along this line.

The fact that the station is really a bulk supply station, so situated with regard to its customers that 12,000-volt and 33,000-volt energy must be sent out, is perhaps the greatest single controlling factor underlying the design. The rating of each of the first two generators is 12,500 kva., 12,000 volts, three-phase, 60-cycle, 1800 r.p.m. This rating is based on a maximum temperature in the armature of 100 deg. C. and in the field of 135 deg. C. with cooling air entering the machine at 40 deg. C. Twelve thousand volts was chosen as generator potential because this is standard in the company's newer plants. The generator windings, which are designed to give each machine 13 per cent inherent reactance, are Y-connected, the neutral point of each being connected through a non-automatic oil switch to a common grounding bus which is earthed through one grounding resistance. Each generator is equipped with a signal indicator and with signal stands. Direct-connected to each machine is a 100-kw., 250-volt shunt-wound interpole exciter. One 100-kw. steam-turbine-driven exciter is also installed as a reserve. Voltage regulation of the generator is controlled by an automatic voltage regulator.

Location of Switching Equipment

Most of the electrical equipment for the station is installed adjacent to the turbine room in what is termed the main switch house. It is built integral with the remainder of the station and has equipment on four levels, namely, the basement floor, the main floor, which is on the same level with the turbine room, the second floor and the roof. The basement contains the step-up and step-down transformers, generator field rheostats and auxiliary power bus structures. The switchboard, the operating room and the brick and concrete 12,000-volt bus structures are on the main floor. The 33,000-volt switching equipment is on the second floor, and the A-frame supports for outgoing lines and the four-tank, sphere-gap electrolytic lightning arresters are on the roof. This arrangement, shown in the cross-section diagram printed in the first part of this article, works out well to keep all leads as short as possible and to keep the heavy transformers at a level where they can be easily handled to and from cars.

From the wiring diagram it will be observed that a double-bus system is employed throughout the station. Each generator may feed through either of a pair of 800-amp., 15-kv. oil switches to a set of sectionalized

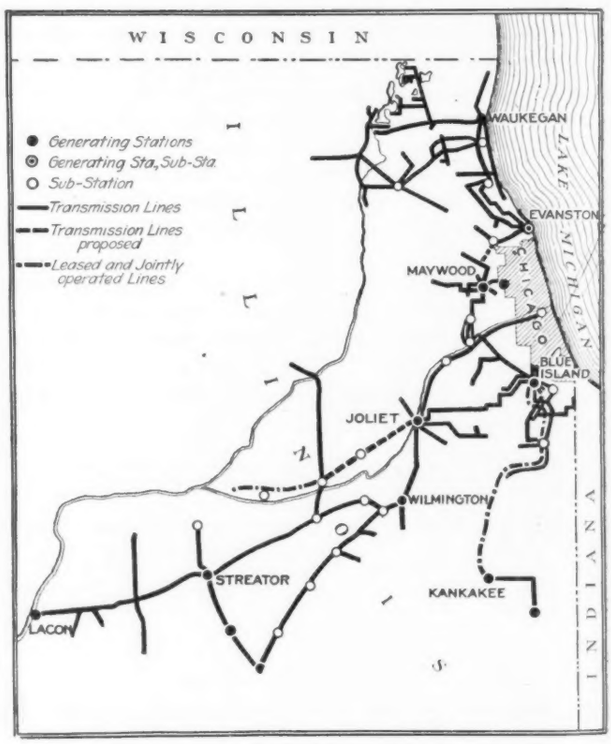


FIG. 1—THE JOLIET STATION IS SITUATED AT THE LOAD CENTER OF THIS SYSTEM

12,000-volt double buses. From these buses two classes of leads are taken off—one, 12,000-volt feeders, and the other, leads to the low-tension side of the step-up transformer. Thirty motor-operated oil switches of the H-3 type, ranging from 300 amp. to 500 amp. each in rating, are used to connect these leads to the double bus. From these switches the eight 12,000-volt feeders, which are identical in layout, mostly go into ducts. The other 12,000-volt leads will go to two banks of 12,000/33,000-volt transformers. One bank of three 3000-kw. delta-delta connected single-phase water-cooled transformers is already installed. It is noticeable in this arrangement that no provision is made for spare transformers, it being the belief that open-delta operation can be

successfully resorted to if emergencies arise. The high-tension leads from these transformers go to another double bus through two 45,000-volt, 300-amp. solenoid-operated G-B type oil-circuit breakers. The arrangement of the 33,000-volt circuits is practically identical with that used for the 12,000-volt lines.

The selection of breakers with liberal rating is one of the outstanding features of the electrical design.

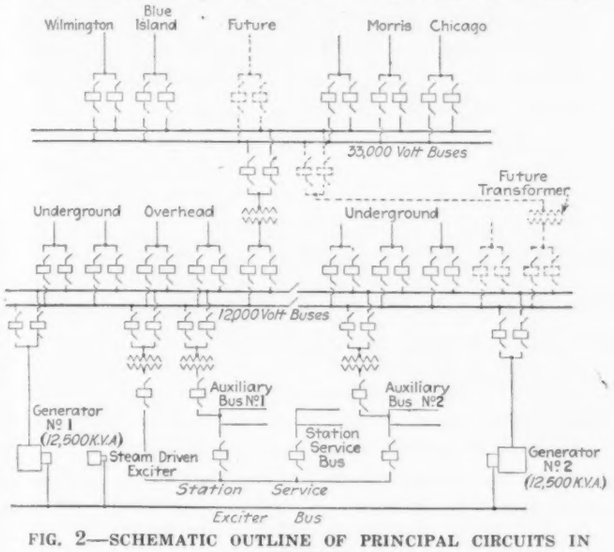


FIG. 2—SCHEMATIC OUTLINE OF PRINCIPAL CIRCUITS IN STATION

This course was followed because it is foreseen that the station will some day be a large one. It is not necessary so far, however, to go to current-limiting reactors to keep within the switch ratings, but space is provided so that reactors can be installed in the future if necessary. Space is provided for sixteen three-phase 33,000-volt switches. The present provision for outgoing 33,000-volt lines will accommodate six. Each of the thirty 15,000-volt and the sixteen 45,000-volt oil switches is arranged so that it can be isolated by six disconnecting switches. Three of each group of six switches are of a special design, which must lock in the open or the closed position before the operator can release the operating rod from the blade. This group of three switches will, of course, be operated first in isolating an oil switch. As a further safety factor, all disconnects are installed in sub-compartments and are hinged on the oil switches so that when the switch is open the blade will be dead.

CENTER OF CONTROL

The control of all electrical equipment, except the auxiliary power, is effected from the operating room, which is in the switch house on the turbine-room floor level. When the building is extended this room will be nearly opposite the middle of the turbine room and separated from it only by a glass partition. From it the operator has a view of the generators and the 12,000-volt switching equipment. Control for the generator is centered in a benchboard, and outgoing feeders are controlled from vertical boards arranged with the benchboard somewhat in the form of a hollow square. The generator circuits are equipped with overload relays, which are ordinarily connected in circuit only during synchronizing. Each outgoing line is equipped with induction-type relays and a polyphase watt-hour meter. Rather liberal use of watt-hour meters has been made.

INFORMATION REGARDING MOST IMPORTANT ELECTRICAL EQUIPMENT

GENERATORS (make and rating), 10,000 kw. (80 per cent power factor), 12,000-volt, 60-cycle, three-phase, 11,800-r.p.m. General Electric.

EXCITERS:
Mounted on shaft 110-kw., 250-volt
Turbine-driven reserve unit .....100-kw.

OIL-SWITCH EQUIPMENT:
12,000-volt .....General Electric
45,000-volt .....Westinghouse

SWITCHBOARD (main) .....Westinghouse

LIGHTNING ARRESTERS .....General Electric

Control for the auxiliary power is centered in a vertical board in the turbine room. From this board, which carries the handles of mechanically operated, remotely situated oil switches in the basement of the switch house, any important electrically operated auxiliary can be controlled. The energy for the motor-driven auxiliaries is supplied by three 900-kw., three-phase, 60-cycle, 12,000/480-volt water-cooled transformers in the basement. One of these is a spare. In fact, any one transformer has sufficient rating to carry the entire auxiliary load. The other two transformers each feed a 440-volt bus. These 440-volt buses, of which there are four, are also arranged for emergency interconnection. Each important auxiliary is served by a separate circuit from these buses. The mechanically controlled oil switch is inserted in each of these circuits at the point where the circuit leaves the bus, and the

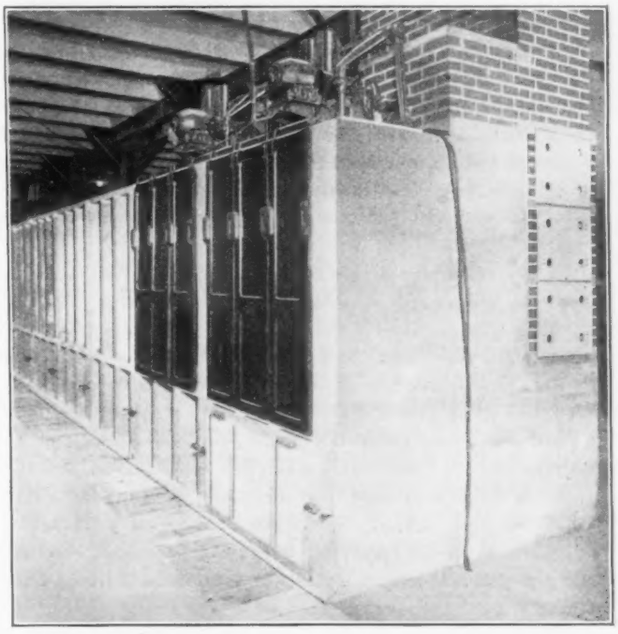


FIG. 3—TYPE OF SWITCH CELL USED WITH OPERATING MECHANISM MOUNTED OVERHEAD

starting apparatus is located immediately at each individual motor. A 40-amp. (eight-hour rating) storage battery installed for emergencies will have rating enough to take care of pilot lamps, motor and solenoid operated oil switches and a few emergency lamps which are switched on automatically in different parts of the building in case of a failure of the alternating-current

source. This battery is charged by a 15-kw., 110/175-volt motor-generator set. The regular source of energy for lighting is a 40-kw., 440/110-220-volt transformer installed in connection with an automatic voltage regulator to insure long life of lamps. The fixtures are of a gooseneck type.

Safety of the employees and congenial surroundings were features which received special prominence in the design of the station. The turbine-room walls are lined with white and green tile. The engineer has a large, roomy office. Shower baths and locker rooms are provided for the employees and excellent drinking water is piped from a nearby spring. Houses are being built near the plant for some of the operating force. In addition to the usual equipment, the station contains a machine shop, a storeroom and a fuel engineer's office, in which coal, the big factor in power-plant operation, will receive close attention. The station was designed by Sargent & Lundy, consulting engineers, assisted by Von Holst & Fyfe, architects. Of the operating company, Samuel Insull is president; Frank J. Baker is vice-president in charge of operation and construction; George H. Lukes, general superintendent, and J. L. Hecht, mechanical engineer.

Simplifying Transmission-Line Calculations

High Accuracy Not Sacrificed Within Extreme Range of Practical Conditions—Method Involves New Equations and Chart Based on Rigorous Formula—Numerical Example

BY T. A. WILKINSON

Electrical Engineer, Westinghouse, Church Kerr & Company, Inc.

THE accurate determination of the voltage, current and power at different points along a transmission line requires, in principle for short lines and necessarily for long lines, the taking into account of the distributed nature of the resistance, inductance and capacity of the circuit. The difficulty and tediousness of the numerical calculations required in using the rigorous formula, involving hyperbolic functions of complex quantities or their equivalent convergent series, have proved a great deterrent to its use, and approximate methods of varying degrees of accuracy have been devised and largely depended on in the solution of practical problems. The simpler approximations are applicable only to quite short lines of moderate voltage, while of the more elaborate methods suitable for longer lines it can only be said that they are somewhat less cumbersome and tedious in application than the rigorous formula.

In the following is presented a new transmission-line formula developed by the writer, by which, with the aid of a simple chart, the calculations are greatly simplified and shortened and the results of the hyperbolic formula obtained in a few minutes, with about the accuracy of a four-place logarithm, for any conditions within the conceivable limits of practical operation. In addition to its simplicity, accuracy and convenience for numerical calculations the formula is inherently instructive and, owing to its unique form, possesses a number of advantages for practical design of circuits and the general investigation of transmission-line characteristics.

Derivation of the Formula

The hyperbolic formula giving the exact relation between the voltage and current at two points along a transmission line, expressed in the form most convenient for the present discussion, is as follows[1] where the conditions at the receiving end are known:

$$E_l = E_o \cosh l\alpha + I_o \times z_o \sinh l\alpha \qquad (1)$$

$$I_l = I_o \cosh l\alpha + E_o \times 1/z_o \sinh l\alpha \qquad (2)$$

[1] See Kennelly, *Transactions A. I. E. E.*, Vol. XXVIII, 1909, p. 698.

where l = distance between the two points in any unit (miles),

$$\alpha = \sqrt{(r + jx)(g + jb)},$$

$$z_o = \sqrt{(r + jx) \div (g + jb)},$$

r = resistance of conductor (ohms per mile),

x = reactance of conductor (ohms per mile),

g = leakage conductance of conductor (mhos per mile),

b = capacity susceptance of conductor (mhos per mile),

E_l and I_l = voltage and current at the sending end,

E_o and I_o = voltage and current at the receiving end.

Where conditions are known at the sending end the formula becomes

$$E_o = E_l \cosh l\alpha - I_l z_o \sinh l\alpha \qquad (3)$$

$$I_o = I_l \cosh l\alpha - E_l 1/z_o \sinh l\alpha \qquad (4)$$

Assuming the conditions of the first formula, the quantities E_o and I_o in (1) and (2) may be regarded as simple numbers. (I_o in general is not a simple number, but this may be disregarded for the present). The other quantities are vector quantities and are to be expressed by complex numbers. For simplicity and brevity in demonstration equations (1) and (2) may be written graphically, as follows, in which form their meaning can be interpreted in terms of simple geometry:

$$E_1 = E_0 \times \text{(Cosh } l\alpha = A \text{ triangle: } a_1, a_2) + I_0 \times \text{(} Z_0 \text{ Sinh } l\alpha = B \text{ triangle: } b_1, b_2) \qquad (5)$$

$$I_1 = I_0 \times \text{(Cosh } l\alpha = A \text{ triangle: } a_1, a_2) + E_0 \times \text{(} \tfrac{1}{Z_0} \text{ Sinh } l\alpha = C \text{ triangle: } c_1, c_2) \qquad (6)$$

From (5) and (6) the hyperbolic formula, in complex notation, may be written:

$$E_l = E_o(a_1 + ja_2) + I_o(b_1 + jb_2) \qquad (7)$$

$$I_l = I_o(a_1 + ja_2) + E_o(c_1 + jc_2) \qquad (8)$$

The vectors A, B and C and their components a_1, a_2, etc., are functions only of the length of line and the quantities r, x, g and b as defined above. When, therefore, the distance l and the frequency and conductor conditions (material, size and spacing) are fixed the vectors and their components become constants which are independent of the voltage and current. The determination of these constants is the troublesome part of transmission-line calculations, and when they are once determined for a given case the calculation of the voltage, current and power at one end of the line for any assumed conditions at the other end is a simple and elementary one.

An approximate algebraic solution for the determination of the line constants has been given by Dr. C. P. Steinmetz.[2] This solution, while quite simple as compared with the rigorous formula, still involves a considerable amount of calculation and the use of trigonometric functions. With the aid of a chart each of the six components, or line constants, a_1, a_2, etc., in (7) and (8) can be expressed separately and calculated, independently of the others, by a very simple expression of one term, derived from the hyperbolic formula, as follows:

The coefficients of E_0 and I_0 in equations (1) and (2) may be expressed in the form of convergent series as follows:

$$\cosh l\alpha = A = 1 + ZY/2! + Z^2Y^2/4! + Z^3Y^3/6! \text{ etc.} \quad (9)$$

$$z_0 \sinh l\alpha = B = Z + Z^2Y/3! + Z^3Y^2/5! + Z^4Y^3/7! \text{ etc.} \quad (10)$$

$$1/z_0 \sinh l\alpha = C = Y + Y^2Z/3! + Y^3Z^2/5! + Y^4Z^3/7! \text{ etc.} \quad (11)$$

in which Z and Y are the impedance $(r + jx)l$ and the admittance $(g + jb)l$ respectively for the whole line.

Denoting the total resistance rl, reactance xl, leakage gl and susceptance bl of the line by R, X, G and B_s, respectively, and substituting for Z and Y in (9), (10) and (11) their complex values, it is possible, by developing the series, to express the coefficients in terms of R, X, G and B_s.

Leaving out the intermediate steps in the calculation, the first two terms of the series for each of the component constants are shown below, equation (12) being transposed to show the value of $(1 - a_1)$.

$$1 - a_1 = (XB_s - RG)/2 - [(B_s^2 - G^2)(X^2 - R^2) - 4RXGB_s]/24 + \text{etc.} \quad (12)$$

$$a_2 = (RB_s + XG)/2 - [RX(B_s^2 - G^2) + GB_s(X^2 - R^2)]/12 + \text{etc.} \quad (13)$$

$$b_1 = R - [2RXB_s + G(X^2 - R^2)]/6 + \text{etc.} \quad (14)$$

$$b_2 = X - [B_s(X^2 - R^2) - 2RXG]/6 + \text{etc.} \quad (15)$$

$$c_1 = G - [R(B_s^2 - G^2) + 2XGB_s]/6 + \text{etc.} \quad (16)$$

$$c_2 = B_s - [X(B_s^2 - G^2) - 2RGB_s]/6 + \text{etc.} \quad (17)$$

Leakage is rarely considered in practical power transmission problems, and consideration of its effect will be left for a later supplementary analysis. Letting $G = 0$ and noting that the sum of the second and following terms of (12) to (17) is in each case a function of R, X and B_s, also that $R = rl$, $X = xl$ and $B_s = bl$, equations (12) to (17) may be written as follows:

$$1 - a_1 = (xb/2)l^2 - f_{a_1}(r, x, b, l) \quad (18)$$

$$a_2 = (rb/2)l^2 - f_{a_2}(r, x, b, l) \quad (19)$$

$$b_1 = rl - f_{b_1}(r, x, b, l) \quad (20)$$

$$b_2 = xl - f_{b_2}(r, x, b, l) \quad (21)$$

$$c_1 = -(rb^2/6)l^2 - f_{c_1}(r, x, b, l) \quad (22)$$

$$c_2 = bl - f_{c_2}(r, x, b, l) \quad (23)$$

The line constants are, to a first approximation, equal to the first terms of equations (18) to (23). Now, by varying the exponent of l in any of the equations the first term can be given any value desired. Then by finding the proper exponents in the six equations the first terms can be made to express the exact values of the respective constants for any assigned values of r, x, b and l. The determination of the exponent, when the constant is known, is simple. Thus, assuming $(1 - a_1)$ to have been determined from given conditions, and letting N_{a_1} equal the corresponding exponent,

$$1 - a_1 = (xb/2)l^{N_{a_1}}$$

$$\log(1 - a_1) = (\log xb/2) + N_{a_1} \log l$$

$$N_{a_1} = [\log(1 - a_1) - (\log xb/2)]/\log l \quad (24)$$

The exponents for the other constants can be found in a similar way so the values of the constants can be expressed by the following equations:

$$1 - a_1 = (xb/2)l^{N_{a_1}} \quad (25)$$

$$a_2 = (rb/2)l^{N_{a_2}} \quad (26)$$

$$b_1 = rl^{N_{b_1}} \quad (27)$$

$$b_2 = xl^{N_{b_2}} \quad (28)$$

$$c_1 = -(rb^2/6)l^{N_{c_1}} \quad (29)$$

$$c_2 = bl^{N_{c_2}} \quad (30)$$

in which N_{a_1}, N_{a_2}, etc., are variable exponents of the distance l, to be determined for the given conditions in any particular case.

The above equations constitute the new transmission-line formula, and for its practical application it is necessary to find a simple means of determining the various exponents. These are taken directly, without calculation, from the exponent chart presented herewith.

THE EXPONENT CHART

The sole purpose of the exponent chart is the determination of the exponents to be used in equations (25) to (30). Its construction is deduced as follows:

Assuming a circuit with a given material, size and spacing of conductors, the values of resistance r, inductance L and capacitance C per mile of circuit become fixed. This circuit may be called, for convenience, the standard circuit. Assuming, further, a definite frequency and length for this circuit, the quantities x, b and l also become fixed and the component line constants a_1, a_2, etc., can be calculated, for the given conditions, from equations (9), (10) and (11). The corresponding exponents N_{a_1}, N_{a_2}, etc., in (25) to (30) can then be calculated as in equation (24). Similar calculations can be made for other frequencies and lengths of circuit within any desired range.

By calculating the exponents for a sufficient number of lengths and frequencies at proper intervals and plotting the results, curves can be drawn from which the exponents for the standard circuit can be determined graphically for any length and frequency desired.

In the exponent chart, here published, the distance curves are straight lines radiating from a common center. The left-hand, or 60-cycle, ordinate in each diagram is a straight line. Mathematically the other

[2] *Transactions A. I. E. E.*, Vol. XXVIII, 1909, p. 712.

frequency lines are curves, but the curvature in all cases is so slight as to be scarcely measurable. There is also a slight divergence of the frequency lines toward the higher exponent values. This is hardly noticeable.

In making the numerical calculations it was noted that the exponent N_{c_2} for any condition up to 700 miles and 60 cycles is identical within 0.00005 with the decimal part of N_{a_2}. This permits combining the diagrams for these two exponents, the decimal part only of N_{a_2} being the value of N_{c_2}.

THE STANDARD CIRCUIT

The conditions assumed for the standard circuit were chosen with a view to representing intermediate values between the practical extremes that might occur within the intended range of application of the formula. With a view to giving it the widest practicable range of application and usefulness and making it available for the analysis of long and unusual lines, the exponent chart has been constructed for distances up to 700 miles and frequencies up to 60 cycles.

Seven hundred miles was chosen as the logical limit of distance, being approximately a quarter-wave length at 60 cycles, and thus permitting the peculiar characteristics of this particular type of line to be conveniently analyzed. Furthermore, this was the length proposed for the Victoria Falls transmission line in South Africa, which is, as far as the writer is aware, the longest line that has been discussed or investigated as a commercial proposition. Based on these considerations, the values $r = 0.1$ ohm, $L = 2.11$ millihenries, $C = 0.0145$ microfarad, were assumed for the linear constants of the standard circuit per mile of wire, corresponding approximately to a 575,000-circ. mil copper conductor with a spacing of 17.5 ft. (5.3 m.).

ACCURACY OF THE FORMULA

The formula is rigorous for the conditions of the standard circuit, and the exponent chart on which its application depends is accurate to within an exponent value of 0.00005. For other line conditions the exponents are affected to a small extent by changes in the linear constants, r, L and C. The effect on the exponents is very slight for any conceivable changes within the limits of practical design and where not entirely negligible is capable of easy correction by means of the supplementary diagrams on the chart.

The exponents have been calculated for the extreme conditions of every change or combination of changes that can occur in the values of r, L and C, within the following range of materials, size and spacing of conductor.

Material	Copper and aluminum
Size, maximum	2,000,000 circ. mils.
Size, minimum	Varies with l; fixed by condition $R_{max} = 100$ ohms
Spacing, maximum	33 ft.
Spacing, minimum	Varies with l; fixed by condition $L_{min} = 1.92$; equals 8 ft. at 700 miles, decreasing to 2 ft. at 50 miles

While the detailed analysis and calculations are too long to be included in the present article, the following interesting and practical results are found:

1. The maximum effect on exponents N_{a_2}, N_{b_1}, N_{c_1} and N_{c_2} of any possible variation in line conditions within the above limits is 0.00032, corresponding to a maximum effect on constants a_2, b_1, c_1 and c_2 of 0.21 per cent.

2. The maximum effect on exponents N_{a_1} and N_{b_2} of any possible changes in L or C, as affected by size or spacing of conductor, is 0.00050, corresponding to a maximum effect on constant $1 - a_1$ and b_2 of 0.27 per cent.

3. The maximum effect on exponents N_{a_1} and N_{b_2} due to changes in r, is 0.0015 and 0.0035 respectively, corresponding to a maximum effect on $1 - a_1$ of 0.6 per cent and on b_2 of 1.4 per cent.

4. The effect of changes in r on exponents N_{a_1} and N_{b_2} is practically independent of the frequency.

The effect of changes in r on exponents N_{a_1} and N_{b_2} is shown, and correction made therefor by means of the supplementary diagrams on the exponent chart. The effect of and correction for any value of r is found on the bottom scale vertically below the intersection of the value of r on the left-hand scale and the curve for the distance. With this correction provided for, the limit of error is reduced to 0.3 per cent for any condition within the range of the exponent chart.

EFFECT OF LEAKAGE

Leakage being variable and uncertain in value, refinement in calculations of its effect is unnecessary. It is determined with sufficient accuracy by the first terms of equations (12) to (17) in which it occurs, except in the case of c_1, where two terms are needed for a satisfactory approximation.

From a series of calculations made by the writer the following results are summarized to show the effect of leakage in per cent on the constants of the standard circuit under various conditions. The value of g assumed in the calculations was 0.2725 micromho, or $1/20b$.

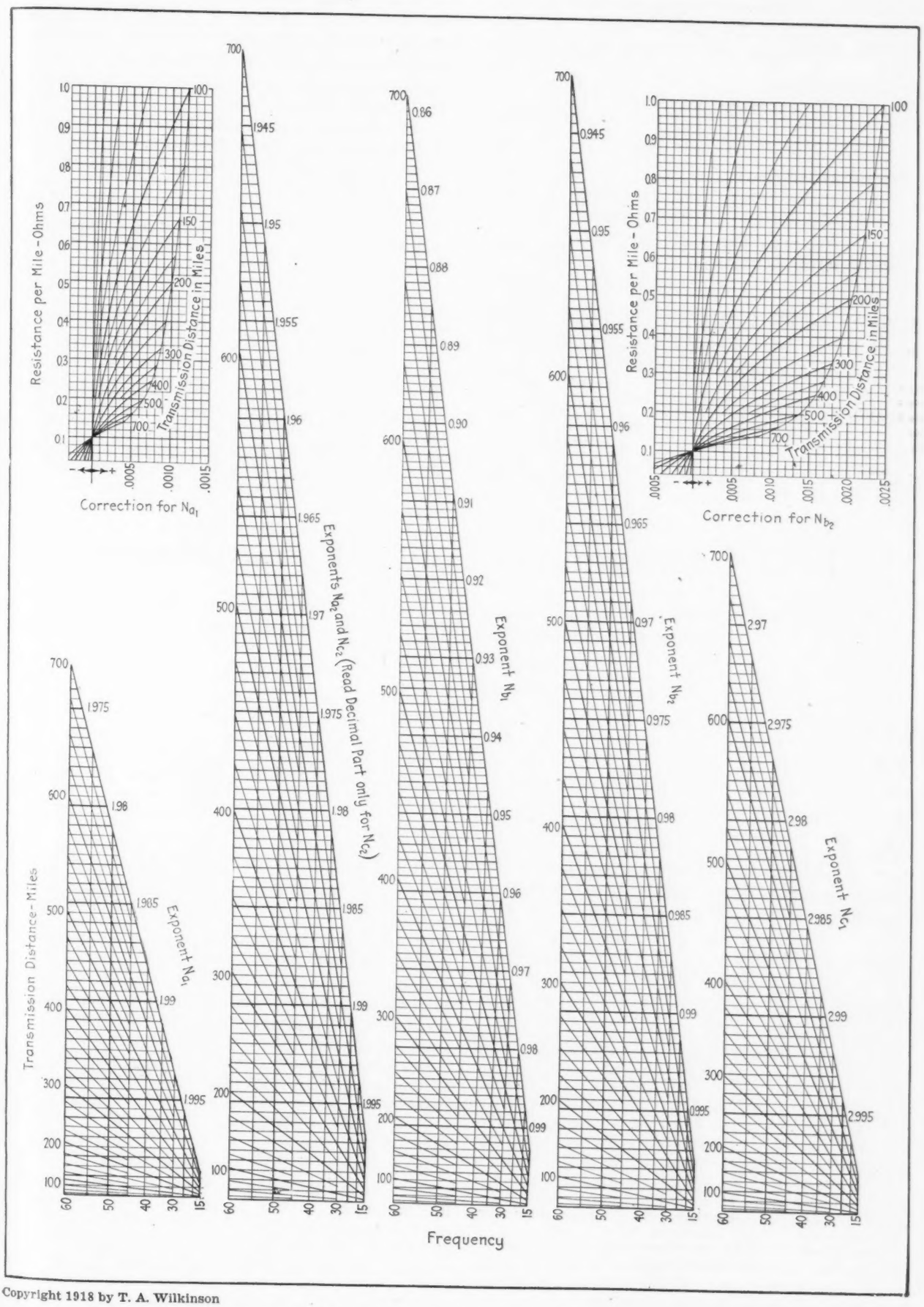
	$1-a_1$	a_2	b_1	b_2	c_1	c_2
700 miles—60 cycles	−0.25	+40.3	−28.8	+0.45	−55.0	+0.56
700 miles—30 cycles	−2.12	+40.3	− 3.9	+0.45	− to +	+0.51
100 miles—60 cycles	−0.62	+40.1	− 0.3	+0.01	− to +	+0.04

From the above it will be seen that leakage affects principally constants a_2, b_1 and c_1, its effect on the other constants being negligible under all conditions. Its effect on a_2 is seen to be practically independent of frequency and distance, while the effect on b_1 is only important at maximum distance and frequency. The relatively large effect on c_1 is numerically unimportant owing to the small value of this constant, the most important result in this case being the change in sign at low frequencies and short distances.

With the exception of c_1 the first terms of (18) to (23) are identical with the values of the line constants as calculated by two of the simplest approximate methods that take account of capacity by assuming it to be concentrated at the center or ends of the line. The integral exponents 1, 2 and 3, therefore, correspond to the assumption of lumped capacity, and the differences between these and the actual exponents represent the effect on each component constant of the distributed nature of the resistance, inductance and capacity of the circuit. The relative effect on each exponent is shown by the height of the respective diagrams on the exponent chart (allowing for the different scale of N_{b_1}).

NUMERICAL EXAMPLE

The following example will illustrate the use of the exponential formula in determining the line constants



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EXPONENT CHART FOR USE WITH EXPONENTIAL TRANSMISSION-LINE FORMULA

for a particular case. The solution of complete transmission line problems will be given in a later article.

Assume: Distance, 275 miles; frequency, 60 cycles; conductor, 250,000-circ. mil. stranded copper; spacing, 8 ft.

From wire tables:

$r = 0.228$ ohm,
$x = 0.753$ ohm,
$b = 0.00000581$ mho.

From exponent chart:

$N_{a_1} = 1.9956$, $N_{b_2} = 0.9909$,
$N_{a_2} = 1.9901$, $N_{c_1} = 2.9941$,
$N_{b_1} = 0.9798$, $N_{c_2} = 0.9901$.

From logarithmic tables:

	Constant					
	$1-a_1$	a_2	b_1	b_2	c_1	c_2
log exponent	0.3001	0.2989	$\bar{1}$.9911	$\bar{1}$.9960	0.4763	$\bar{1}$.9957
lolog 275	0.3873	0.3873	0.3873	0.3873	0.3873	0.3873
lolog l^N	0.6874	0.6862	0.3784	0.3833	0.8636	0.3830
log l^N	4.869	4.855	2.390	2.417	$\bar{7}$.305	2.415
log r	.....	$\bar{1}$.358	1.358	.....	$\bar{1}$.358	.....
log x	$\bar{1}$.877	.....	.....	$\bar{1}$.877	.....	.....
log b (×2 for c_1)	$\bar{6}$.764	$\bar{6}$.764	.....	.....	$\bar{11}$.528	$\bar{6}$.764
log ½	$\bar{1}$.699	$\bar{1}$.699	.....	.....	.....	.....
log k	.....	.....	.....	.....	$\bar{1}$.222	.....
log constant	$\bar{1}$.209	$\bar{2}$.676	1.748	2.294	$\bar{5}$.413	$\bar{3}$.179
constant	0.162	0.0474	56.0	197.0	−0.0000259	0.00151
a_1	0.838	.....	.....	.....	.....	.....

Find conditions at the sending end when the above line is delivering 30,000 kw. at 150,000 volts, with unity power factor. Letting P_0 and P_l equal kilowatts at receiving and sending ends respectively, the following conditions exist for one phase:

$E_0 = 150{,}000/\sqrt{3} = 86{,}600$ volts.
$P_0 = 30{,}000/3 = 10{,}000$ kw.
$I_0 = 10{,}000/86.6 = 115.5$ amp.
$E_l = 86{,}600(0.838 + j0.0474) + 115.5(56 + j197)$
$= (72{,}600 + j4105) + (6470 + j22{,}750)$
$= (79{,}070 + j26{,}855)$
$= 83{,}500$
$I_l = 115.5(0.838 + j\,0.0474) + 86{,}600(-\,0.0000259 + j\,0.00151)$
$= (96.8 + j5.47) + (-2.24 + j131)$
$= 94.6 + j136.5$
$= 166$
$P_l = 79{,}070 \times 94.6 + 26{,}855 \times 136.5$
$= 11{,}146$

At no load:

$E_l = (72{,}600 + j4105) = 72{,}700$ volts.
$I_l = (-2.24 + j131) = 131$ amp.
$P_l = -162.6 + 537.7 = 375.1$ kw.

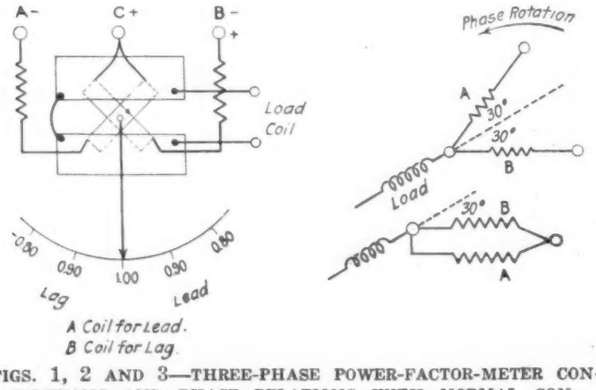
Regulation $= (72{,}700 - 83{,}500)/86{,}600 = -12.5\%$.
Efficiency $= 10{,}000 \div 11{,}146 = 89.7\ \%$.

D. C. Calibration of Power-Factor Meters

Resistance Ratio Method Employed to Eliminate Errors Caused by Variations in Voltage, Current and Phase Angles When Alternating Current Is Used

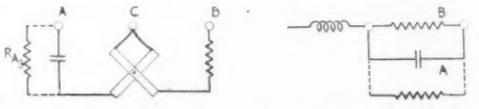
BY THOMAS W. VARLEY

WHEN a three-phase power-factor meter is calibrated by actually adjusting the power factor, it usually requires two voltmeters, one ammeter, one wattmeter and five men to take readings. With variations in voltage and current it is almost impossible to check any point on the scale. These difficulties are easily overcome by using direct current and adjusting the total resistance in the movable-coil circuits so that they will have the relation indicated in the accompanying table. The values given in the table apply to two-phase and three-phase power-factor meters of the dynamometer type.



FIGS. 1, 2 AND 3—THREE-PHASE POWER-FACTOR-METER CONNECTIONS AND PHASE RELATIONS WITH NORMAL CONNECTIONS AS WELL AS WHEN MOVABLE COILS ARE IN PARALLEL

Without knowing the phase advance of the condenser used in conjunction with the single-phase power-factor meter to be calibrated it is impossible to give the ratio of total resistances which should exist for checking given points on the instrument scale. The phase advance caused by the condenser alone is usually over 89 deg., but combined with the coil *A* may change to 85 deg. Furthermore, single-phase power-factor meters are subject to frequency errors due to the capacity or inductance in the circuit.



FIGS. 4 AND 5—SINGLE-PHASE METER CONNECTIONS AND METHOD OF SIMULATING EFFECT OF CONDENSER

The values given in the accompanying table are based on the fact that the deflection of a dynamometer-type power-factor meter is equivalent to the combined torques of the movable coils *A* and *B* in the field of the load coil. The torque of each of these coils is proportional to the voltage impressed across it and the cosine of the angle between the load current and the applied voltage. Hence, at 100 per cent power factor the two torques balance. In other words, by adjusting the relation between the currents in the movable coils, the resultant torque with direct current can be made to equal any obtained when the instrument is connected to a polyphase circuit with any power-factor load.

For instance, to determine the resistance ratio which should be obtained to indicate 90 per cent power factor (equivalent to cosine of 20 deg. 50 min.) consider the relation between the current in the movable and load coils for a three-phase dynamometer-type power-factor instrument (Fig. 2). In this case the vector positions of the currents in coils *A* and *B* (Fig. 2) would be shifted 25 deg. 50 min. clockwise, making the angles between the currents in the movable coils and that in the load coil 4 deg. 10 min. and 55 deg. 50 min. for coils *A* and *B* respectively. Under these conditions the torques of the individual movable coils would be proportional to the cosines of these angles, or in the relation 0.9974 to 0.5616. Thus to simulate these torques with direct current, assuming that the normal resistance of circuit *CB* is R_b and that of *AC* is R_a, the resistance of circuit *CB* should be changed to $R_b \times 0.9974 \div 0.5616 = 1.77\ R_b$.

The ratio of the total resistances of circuit *AB* and *CB* to obtain other power-factor deflections with direct current can be obtained in a similar manner. However, it will be found that the current through one of the circuits will have to be reversed in addition to changing the resistant ratio to obtain deflections corresponding to power factors of 70 deg. and less (two-phase) and 40 per cent and less (three-phase). This can be done without altering the instrument connections by joining *A* and *B* in series, making the current through *B* negative, and connecting a shunt across the circuit which is to have the higher resistance. Thus, if *BC* is to have 0.1108 ÷ 0.8047 normal current in the negative direction (as required at 40 per cent power factor), the shunt will have to carry (0.8047 — 0.1118) ÷ 0.8047 of the total current, or its resistance will have to be 0.1118 ÷ 0.6929 × R_{b_1} = 0.162 R_b, where R_b is the normal resistance of circuit *CB*. The values of the shunts for different deflections are given in the table.

TOTAL RESISTANCE* NECESSARY IN MOVABLE COILS TO GET DIFFERENT POWER-FACTOR DEFLECTIONS WITH DIRECT CURRENT

(Use about full-load current and about normal voltage to get a good torque. Alternating current or direct current can be used.)

Figures in bold-face type indicate value of shunt needed to produce required current in circuit.

Power Factor		Three-Phase		Two-Phase	
Lead	Lag	A	B	A	B
100		$+R_a$	$+R_b$	$+R_a$	$+R_b$
95		$+R_a$	$+1.46R_b$	$+R_a$	$+1.97R_b$
	95	$+1.46R_a$	$+R_b$	$+1.97R_b$	$+R_b$
90		$+R_a$	$+1.77R_b$	$+R_a$	$+2.78R_b$
	90	$+1.77R_a$	$+R_b$	$+2.78R_a$	$+R_b$
85		$+R_a$	$+2.11R_b$	$+R_a$	$+4.25R_b$
	85	$+2.11R_a$	$+R_b$	$+4.25R_a$	$+R_b$
80		$+R_a$	$+2.53R_b$	$+R_a$	$+7.02R_b$
	80	$+2.53R_a$	$+R_b$	$+7.02R_b$	$+R_a$
70		$+R_a$	$+3.87R_b$	$+R_{a1}$	$\mathbf{0.0101}R_{b1}$
	70	$+3.87R_a$	$+R_b$	$\mathbf{0.0101}R_a$	$+R_b$
60		$+R_a$	$+7.66R_b$	$+R_{a1}$	$\mathbf{0.167}R_{b1}$
	60	$+7.66R_a$	$+R_b$	$\mathbf{0.167}R_{a1}$	$+R_{b1}$
50		$+R_a$	Open circuit	$+R_{a1}$	$\mathbf{0.366}R_b$
	50	Open circuit	$+R_b$	$\mathbf{0.366}R_{a1}$	$+R_{b1}$
40		$+R_{a1}$	$\mathbf{0.162}R_{b1}$	$+R_{a1}$	$\mathbf{0.835}R_{b1}$
	40	$\mathbf{0.162}R_{a1}$	$+R_{b1}$	$\mathbf{0.835}R_{a1}$	$+R_{b1}$
30		$+R_{a1}$	$\mathbf{0.407}R_{b1}$	$+R_{a1}$	$\mathbf{1.09}R_{b1}$
	30	$\mathbf{0.417}R_{a1}$	$+R_{b1}$	$\mathbf{1.09}R_{a1}$	$+R_{b1}$
20		$+R_{a1}$	$\mathbf{0.917}R_{b1}$	$+R_{a1}$	$\mathbf{1.95}R_{b1}$
	20	$\mathbf{0.917}R_{a1}$	$+R_{b1}$	$\mathbf{1.95}R_{a1}$	$+R_{b1}$
10		$+R_{a1}$	$\mathbf{2.39}R_{b1}$	$+R_{a1}$	$\mathbf{4.49}R_{b1}$
	10	$\mathbf{2.39}R_{a1}$	$+R_{b1}$	$\mathbf{4.49}R_{a1}$	$+R_{b1}$
0		$+R_{a1}$	$-R_{b1}$	$+R_{a1}$	$-R_{b1}$
	0	$-R_{a1}$	$+R_{b1}$	$-R_{a1}$	$+R_{b1}$

*R_a is the normal resistance of coil A, R_b that of coil B, and R_{a1} and R_{b1} the normal resistances of coils A and B when connected in series.

OUTLINE OF CALCULATIONS FOR RESISTANCE RATIOS NECESSARY IN CALIBRATING SINGLE-PHASE METERS WITH DIRECT CURRENT

Power Factor* = 0.90 = cos 25° 50′

Leading:

A	*B*
89°—25° 50′=63° 10′	0° + 25° 50′ = 25° 50′
cos 63° 10′=+0.4515	cos 25° 50′ = 0.9
Change resistance for *A* to $R_{a3} \times (0.9000/0.4514)$.	R_b = normal

Lagging:

A	*B*
89° + 25° 50′ = 114° 50′	0° — 25° 50′ = —25° 50′
cos 114° 50′ = —0.42	cos 25° 50′ = 0.9

The current through circuit *A* becomes negative and the case is similar for power factor 0.40 leading, with a three-phase indicator. Call the resistances for circuits *A* and *B*, R_{a4} and R_{b4}.

Shunt R_{a4} by $R_{a4} \times (0.42/0.48)$.	R_{b4} normal

Power Factor = 0 = cos 90°

Leading:

A	*B*
89° — 90° = —1°	0° + 90° = 90°
cos — 1° = 0.9999	cos 90° = 0
R_{a4} *normal*	R_{b4} open circuit

Lagging:

A	*B*
89° + 90° = 179°	0° — 90° = 90°
cos 179° = —0.9999	cos 90° = 0
R_{a4} on alone and reversed	R_{b4} open circuit

*Similarly for power factors 0.80, 0.70, 0.60, 0.50, 0.40, 0.30, 0.20 and 0.10.

Calibration of Single-Phase Meters

To calibrate a single-phase power-factor meter using a condenser to advance the phase of the current through coil *A*, substitute a resistance for the condenser sufficient to give an indication of 1.00 on the scale (Fig. 5). The resistance R_{a_2} will be found to be very high, as the condenser for which it is substituted has a large angle of advance for its current, and hence an apparently high resistance. With coil *B* alone connected the pointer may be deflected slightly on the lag side of 100 per cent power factor, whereas with coil *A* alone the pointer may show a large angle on the lead side of 100 per cent power factor. Call the first point zero and the second 90, thus forming a quadrant. The position of the pointer with both coils energized gives the true angular advance of the condenser in terms of 0 and 90 as found. For convenience in presenting the accompanying calculations this angle will be considered as one degree. The real resistance for circuit *A* will then equal $R_{a_2} \times$ cos 89 deg. = R_{a_3}. The angle of 89 deg. advance for the condenser is used to simplify the explanation, but the real angle, found by testing, should be used.

Employing the resistance ratio method calibrating power-factor meters, only one man is required to mark the scale and no attention need be paid to variations in voltage or current. This is a valuable time-saver.

Application of Motors to Steel-Mill Operations

Limitations to Speed of Mills—Power Requirements and Types of Motors Adapted Thereto—Control of Reversing Mills and Relative Economy of Steam and Electric Drive

BY C. E. CLEWELL

Assistant Professor of Electrical Engineering, University of Pennsylvania

Some important operations in steel mills to which motors have been applied are touched upon in this article. Notes on the arrangements of mill machinery, items which affect the power requirements of the motors, the principal types of motors used and features of the control apparatus are included. Economies which may be effected by the motor in comparison with steam-driven rolls are discussed, and reference is made to several interesting applications which are illustrated from practical cases.

A COMPLETE study of motor applications in steel-mill work would include the operation of such machinery as cranes, reversing and non-reversing stationary tables, manipulators, screw-downs, the operation of lift tables to include the lift motion as well as driving the rollers, and the field of general reversing and non-reversing applications. Obviously it would be impracticable, in a limited article of this kind, to attempt to treat completely each of these special applications. As a consequence the present discussion will be limited to one or two specific cases where the motor has resulted in a successful use of the principles on which the industrial applications of electric power have been based in recent years.

Arrangement and Drive of Mills

Mills are arranged in various ways. Where small sections of metal are handled by a series of stands they may be arranged in one line and the power applied either at one end or at the center of the line. However, where roughing and finishing stands are included in one group, the roughing stands are usually operated at reduced speed, and the power is sometimes applied to wheels through rope drive, whereas the finishing stands may be directly connected to the motor for higher-speed operation. Such a scheme means, however, a fixed relation between the speed of the roughing rolls and that of the motor which is used also for the finishing rolls. With separate motors for each set of rolls the speeds of each may be adjusted independently to suit the best production conditions.

Various methods of mechanically connecting the motors to the rolls are employed, notably direct connection, gearing and rope drives. Where direct connection is considered it is necessary that the mill speed be adapted to the motor speed which is possible with the size of motor used. Sykes, in the "Standard Handbook for Electrical Engineers," gives the following speeds for 25-cycle motors as a minimum: 250 hp. to 500 hp., 125 r.p.m.; 500 hp. to 1000 hp., 100 r.p.m.; 1000 up to 2000 hp., 85 r.p.m.; 2000 hp. and upward, 70 r.p.m. These values indicate the necessity for certain limitations of the speeds of the mills if direct connection is to be employed.

To use motors with these minimum speeds implies a relative high first cost for the motor so that the geared connection is sometimes resorted to for the operation of small low-speed rolls by motors of higher speed ratings than would be possible with direct connection.

The table, which indicates a number of typical motor applications to the main rolls of steel mills, shows the preponderance of alternating-current motors, this type being used in a majority of cases. However, alternating-current motors are not adapted to the reversing mills, and in this case the direct-current type must be used on account of its greater flexibility of control.

Modern mill motors are designed to withstand the high temperatures which often occur at the points where the motor must be installed. Improvements along this line have resulted in a motor for which the maintenance is greatly reduced over that which was experienced with earlier types.

Control for the Reversing-Mill Motor

Some criticism has been made of the developments in the control of direct-current motors in recent years, due to the practice of inserting resistance in the armature circuit, which in itself represents very little or no advance over the methods of ten or twenty years ago. A notable example of a departure from this method, however, is in the control of the large direct-current motors used with reversing rolls. Here, a motor generator set (Fig. 1) is employed for the supply of each driving unit, the generator supplying adjustable voltage to the driving motor for the speed variation of the latter. Reversal of the driving motor is accomplished by a reversal of the supply voltage from the generator, which is brought about in turn by a reversal of the generator-field excitation.

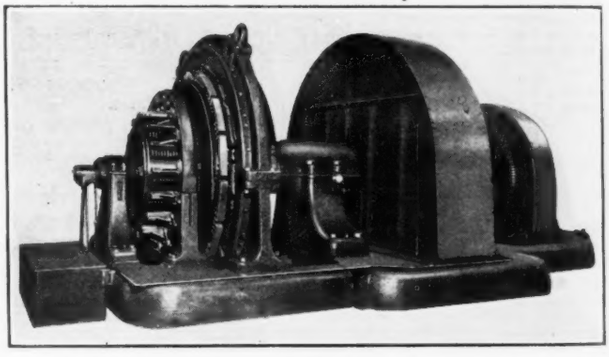
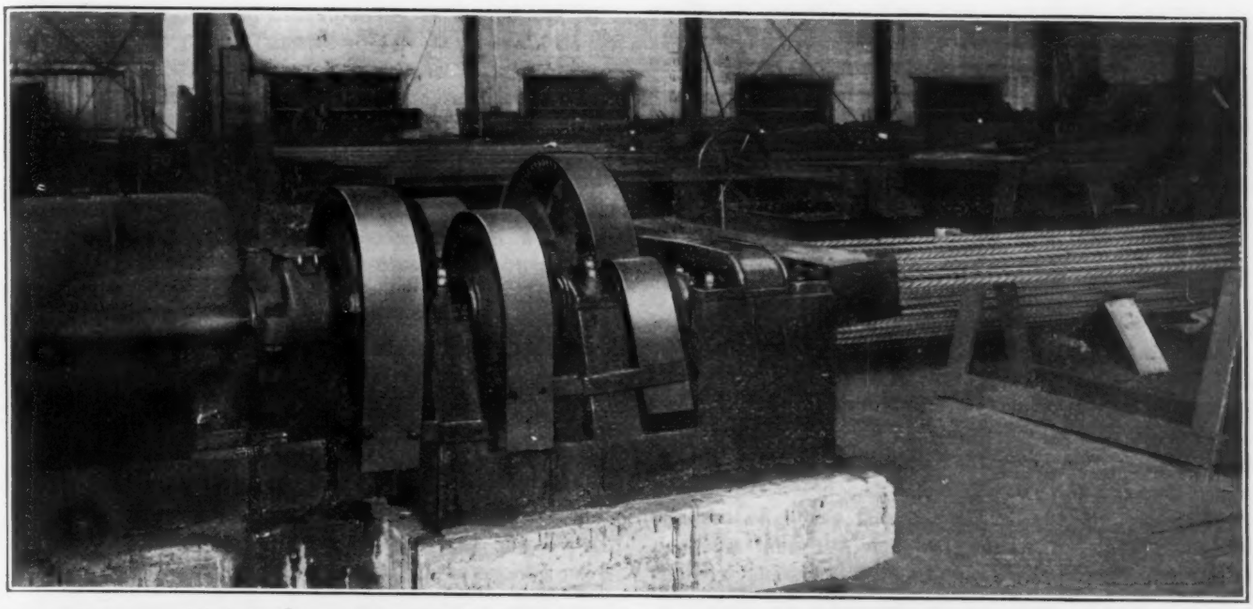
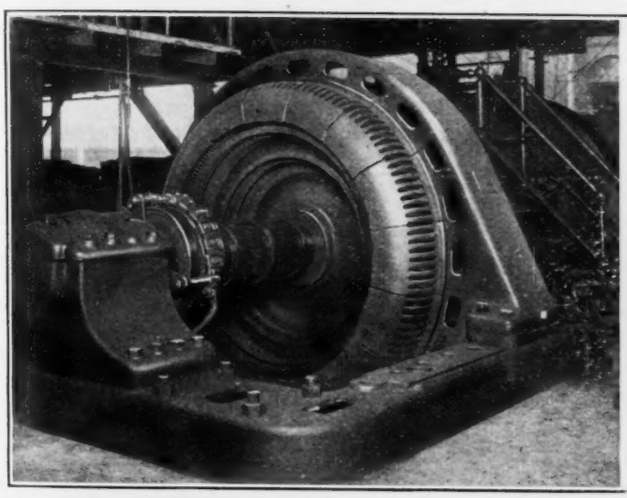


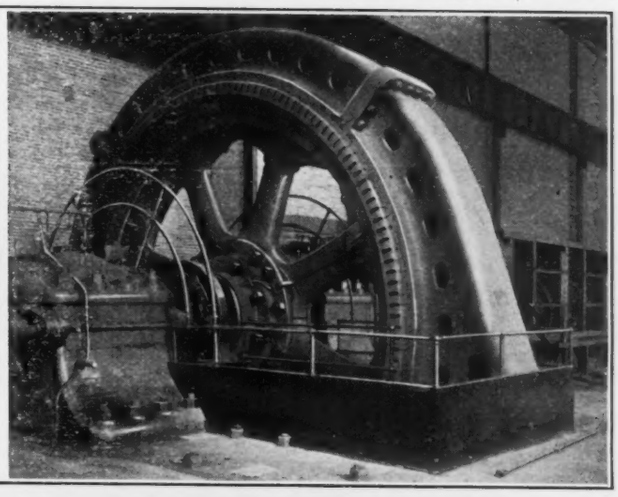
FIG. 1—FLYWHEEL MOTOR-GENERATOR SET SUPPLYING POWER TO REVERSING MILL

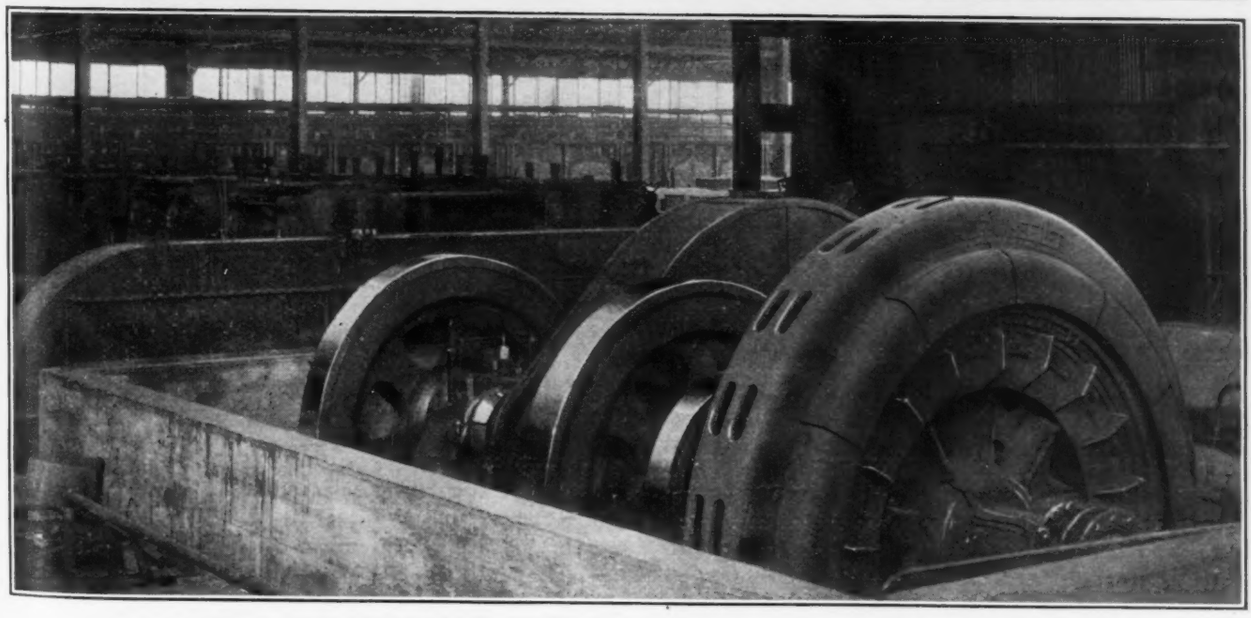
With increased loads on the driving motor, the emf. of a second exciter termed the "series" exciter increases, since the driving-motor armature current passes through the field winding of this series exciter. This results in increased excitation for the driving motor, consequently reduced speed and less mechanical strain on the equipment, with some increase in driving torque.

With the master controller now thrown toward its









FIGS. 2, 3, 4 AND 5—MOTORS APPLIED TO SEVERAL DIFFERENT STEEL MILL MACHINES

Fig. 2 shows a 75-hp. mill-type motor driving bar-twisting machine at works of Inland Steel Company; Fig. 3 is a 1500-hp. mill motor applied to rolls in the Spang Chalfant Company; Fig. 4 illustrates a 6000-hp. induction motor driving a sheet-bar mill at works of Indiana Steel Company, and Fig. 5 is a 1200-hp. 238 r.p.m. induction motor geared to cold rolls

off position, the excitation of the generator field is reduced and the driving motor returns electric power to the generator, thus operating the latter as a motor for the time. This results in an increase in speed for the motor-generator set with consequent storage of energy in the flywheel of the set (Fig. 1). In this way the speed of the driving motor is quickly reduced to zero and a large part of the energy required for acceleration is conserved by the flywheel[1] and used in turn for the succeeding operation.

Among the items which determine the power requirements imposed on the driving motor of the motor-generator set, the flywheel will apparently have a considerable bearing, its tendency being to equalize the load on the main supply circuits. As for the loads throughout the duty cycle of the reversing driving motor, extreme variations follow as a consequence of the differences in the reductions of the material which is passed through the rolls and also because of the heavy requirements at the instant the material enters the rolls. The size of motor for driving must be such that it will supply these varying requirements without excessive heating, and the design must be such that the maximum torques and horsepower demands, which are very large at times, may be met successfully.

The practice has been to rate reversing mills on the maximum peaks of the operating load rather than on continuous capacity based on heating. The limitations of this article prevent a detailed treatment of the design features which have been included in motors for this service, but in a supplementary note at the end of this article a number of references are given to comprehensive papers on various phases of the subject, to which the reader is referred for additional information.

[1]A more complete discussion related to the use of flywheels for such purposes will be given in a subsequent article dealing with this specific subject.

ECONOMIES IN THE USE OF THE MOTOR

A number of excellent papers have appeared recently which have dealt more or less fully with the advantages and economies of the motor-driven reversing mills in contrast with steam-engine power applications. As an example, an article in these columns[2] recently explained in considerable detail the comparative costs and performance of different types of drives, and for this reason it has been thought best to include at this point merely a brief statement of the factors involved in the way of a review or summary of the present attitude toward the electrically driven reversing mill, with an appended note on the more important papers, which may be consulted where greater detail is desired.

While the first cost of the reversing engine is set forth by the engine builders as only a small fraction of the total cost of the electric drive, carefully compiled figures on both kinds of equipment, when based on the total costs chargeable against the reversing-mill equipment, show that electric drive with purchased power has a lower first cost than, and the electric drive with power generated at the plant has a first cost comparable with, that of the steam drive. It is of course highly necessary in arriving at such a conclusion to include for the steam drive not only the reversing engine, but also the condenser equipment, foundations, boilers, piping and the like.

Messrs. Sykes and Hall[3] give as the first cost of equipment for driving a 40-in. (101.6-cm.) blooming mill with a capacity of 60,000 tons of steel per month for reducing from 24 in. by 24 in. (61 cm. by 61 cm.) to 8 in. by 8 in. (20.3 cm. by 20.3 cm.), the following figures: (a) Electric drive with purchased power,

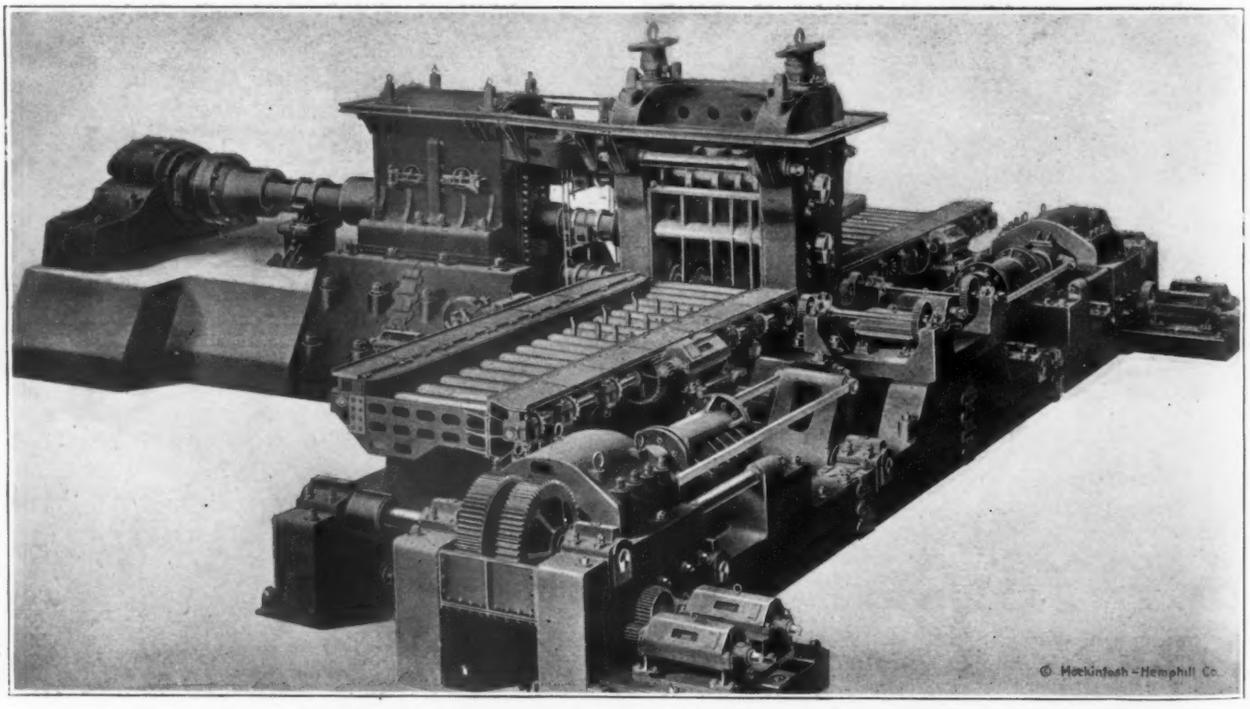


FIG. 6—BLOOMING MILL USING FOUR 100-HP. MOTORS FOR LIFTING TABLE, TWO 50-HP. MOTORS FOR FEED ROLLERS AND FOUR 50-HP. MOTORS FOR THE ROLL TABLES

[2]By William Knight on "Advantages of Electrified Rolling Mills," Vol. 70, No. 21, p. 998.

[3]Paper on "Electric Drive for Reversing Rolling Mills," by Wilfred Sykes and David Hall, *Trans. A. I. E. E.*, Vol. XXXV, p. 501. References have been freely made to this excellent treatment of the reversing mill in the development of these economic relations.

$195,000; (b) electric drive with power generated at the plant, $325,000; (c) steam drive, $300,000. The reader is referred to the paper of Sykes and Hall and to the ELECTRICAL WORLD article by Knight for further details on costs.

The argument that the reversing engine uses no more steam than the electric drive has been met[3] on a basis of actual tests on a modern engine of this type and corresponding data on electrical equipment. Fig. 7 shows, for example, the horsepower hours per ton of steel rolled with electrically driven reversing mills[4] and the pounds of steam required per ton rolled with steam apparatus. From the first curve and with known values of the pounds of steam required per horsepower-hour for large steam turbines the pounds of steam required by electrically driven mills per ton of steel rolled may be determined. Figures derived on this basis show that the steam consumption for the electric drive amounts only to about one-half of that required by the reversing engine for the same material handled by the mill.

INFORMATION REGARDING A FEW TYPICAL INSTALLATIONS OF MOTORS FOR THE MAIN ROLLS OF STEEL MILLS

(For classification of mills see "Standard Handbook for Electrical Engineers," fourth edition, page 1248)

Name of Plant	Motor				Method of Drive
	Kind and Size of Mill	Hp.	R.P.M., Full-Load Speed	General Description	
Carnegie Steel Co. painters' mill	Finishing std. 9-in. mill	500	435	440-v., 3-ph., 60-cy.	Belted
Carnegie Steel Co. painters' mill	Finishing std. 10-in. mill	500	435	440-v., 3-ph., 60-cy.	Belted
Alton Steel Co	12-in. Morgan mill and 10-in. merchant mill	1,200	292	2200-v., 3-ph., 25-cy.	Direct-connected to 10-in. mill rope drive to 12-in. mill
Alton Steel Co	18-in. tandem mill	800	292	2200-v., 3-ph., 25-cy.	Direct-connected
Alton Steel Co	8-in. merchant mill	700	365	2200-v., 3-ph., 25-cy.	Direct-connected
Alton Steel Co	Finishing std. 10-in. mill, item No. 50	600	485	2200-v., 3-ph., 25-cy.	
Bethlehem Steel Co	35-in. blooming mill	12,000	45–90	600-v., d. c. in 2 units	Direct-connected
CarnegieSteel Co.	10-in. merchant bar mill	1,500	182 to 162	6300-v., 3-ph., 25-cy.	Rope drive and direct
Cambria Steel Co.	16-in. merchant mill	500	181	2200-v., 25-cy., 3-ph.	Direct-connected
Cambria Steel Co.	10-in. merchant mill	500	244	2200-v., 25-cy., 3-ph. (12-pole)	Direct-connected
Cambria Steel Co.	8-in. merchant mill	300	365	2200-v., 25-cy., 3-ph.	Direct-connected
American Steel & Wire Co	Roughing train-rod mill	2,600	81.5	6600-v., 25-cy., 3-ph.	Gear drive
American Steel & Wire Co	Finishing train-rod mill	1,600	500	6600-v., 25-cy., 3-ph.	Rope drive
American Steel & Wire Co	Finishing train-rod mill	1,300	500	6600-v., 25-cy., 3-ph.	Rope drive
Illinois Steel Co.	Roughing rolls, structural mill	3,000	91	2200-v., 25-cy., 3-ph.	Gear drive
Illinois Steel Co.	Finishing rolls, structural mill	1,000	133	2200-v., 25-cy., 3-ph.	Direct-connected
American Rolling Mill Co.	Sheet mill	1,500	10	2200-v., 25-cy., 3-ph.	Rope drive
American Rolling Mill Co.	Sheet jobbing mill	1,000	245	2200-v., 25-cy., 3-ph.	Rope drive
American Sheet & Tin Plate Co.	Finishing rolls, 84-in. plate mill	1,100 1,500	91	6600-v., 25-cy., 3-ph.	Direct-connected
Morris-Bailey Steel Co	Cold-roll mill	350	5	440-v., 60-cy., 3-ph.	Gear drive
Illinois Steel Co.	8-in. merchant mill	400	400 to 450	220-v., d.c., cp.-wd. adj. speed	Direct-connected
Carnegie Steel Co., painters' mill	Merchant mill	500	435	440-v., 3-ph., 60-cy.	Rope
Pittsburgh Steel Products Co.	Piercing mill, seamless tubes	800	200 to 300	500-v., d.c., cp.-wd., adj. speed	Direct-connected
Alan Wood Iron & Steel Co.	84-in. plate mill roughing rolls	1,600	244	2200-v., 3-ph., 25-cy.	Gear drive

[4]Fig. 7 is based on information found in the paper by Sykes and Hall, and on an article by W. R. Runner, Figs. 1, 2, 3 and 4 are shown by courtesy of the General Electric Company, and Figs. 5 and 6 by that of the Crocker-Wheeler Company.

The conservation of all the energy required for acceleration in engine-driven equipments is given[5] little or no weight, since such a claim is based largely on theoretical operating conditions of the engine-driven mill and, moreover, since the reduced energy consumption of the electric drive as outlined in item (2) is obviously the point to be considered in this general

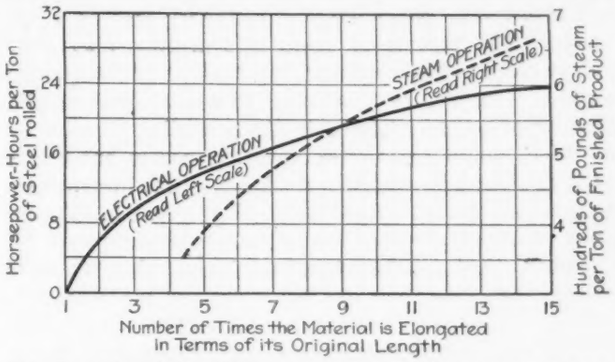


FIG. 7—RELATION BETWEEN INPUT TO ELECTRIC AND STEAM-DRIVEN REVERSING MILLS AND ELONGATION OF THE STEEL ROLLED

connection. In other words, even if the engine drive does save more of the accelerating energy, its gross energy consumed per ton is so much greater than that of the electric drive that this feature is of little or no consequence.

As to reduced efficiency of the motor drive at partial loads, it is pointed out[3] that while the electrically driven mill does suffer some reduction in economy with reduced loads on account of the continued windage and friction losses of the flywheel motor-generator equipment, the net power, without considering these more or less constant losses, per ton of material handled is essentially independent of the quantity which passes through the rolls, and, furthermore, that, owing to the constant losses in an engine equipment, the conditions surrounding its operation are somewhat like those of the motor drive at partial loads.

Concerning the time required for the operation of the two kinds of equipment, tests[3] on each indicate that the electrically driven mill can be operated as rapidly or more so than with engine drive. Besides a number of secondary advantages, such as the ease of control and the like, materially favor the electric drive.

The foregoing discussion has reviewed briefly certain information which is available on steel-mill motive power. Owing to limitations imposed on the discussion by the space available, the reader is referred to the papers and articles mentioned in the bibliography printed below for further information on various phases of the subject.

BIBLIOGRAPHY.—"Modern Types of Direct-Current Machines," by David Hall, *Electric Journal*, Vol. XIII, No. 11, p. 534; "Electrically Driven Reversing Mills," by Wilfred Skyes, *Transactions A. I. E. E.*, 1911; "Operation of a Large Electrically Driven Reversing Mill," by Wilfred Sykes, *Transactions A. I. E. E.*, 1912; "Electrification of a Reversing Rolling Mill of the Algoma Steel Company," by B. T. McCormick, *Transactions A. I. E. E.*, 1912; the three papers on controllers in *Transactions A. I. E. E.*, 1915, by J. S. Riggs, G. E. Stoltz and W. D. Lunn, and Arthur Simon; together with the paper and articles referred to under footnotes 2, 3 and 4.

Central-Station November Operations

Compilation of Returns Made to the "Electrical World" Covering November, 1917, Indicates Increase of 15.3 per Cent in Gross Revenue and 17 per Cent in Kilowatt-Hour Output

CENTRAL-STATION company returns compiled by the ELECTRICAL WORLD still apply to the period last year when industrial activity was at a high point. The reports of operations in November, 1917, show close to the same increased volume of output and gross earnings, as compared with the corresponding month of 1916, indicated in the preceding months.

The available statistics, covering nearly one-half of the industry, show gains of 15.3 per cent in gross revenue from energy sales and of 17 per cent in kilowatt-hour output, in November, 1917, as compared with November, 1916. Although output increased at a greater percentage rate than the gross revenue therefrom, the difference between the two was much smaller than during most of the months in the year covered by the returns. This indicates that apparently the increased rates resulting from the higher cost of operation had a perceptible effect in making the percentage increase in gross revenue more nearly commensurate with the percentage increase in kilowatt-hour output.

Generally the statistics continue to reveal the large rate of growth which has been significant of electric central-station operation for many months. As some time is required for the compilation of the statistics by individual companies and then for their collection and tabulation by the ELECTRICAL WORLD, they necessarily refer to a period which, though recent, does not reflect current conditions. Not for some time will the effect of the Garfield order be apparent in the returns. It should be kept in mind also that the returns for the months of 1918 will be compared with the very high figures of 1917 and may not present the same record of increase on top of increase which has characterized the reports for many months past. In any event, however, the totals of gross output are large.

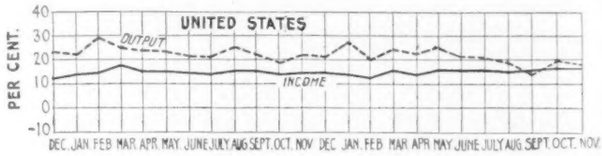


FIG. 1—CENTRAL-STATION INCOME AND OUTPUT GAIN BY MONTHS IN PER CENT FOR UNITED STATES

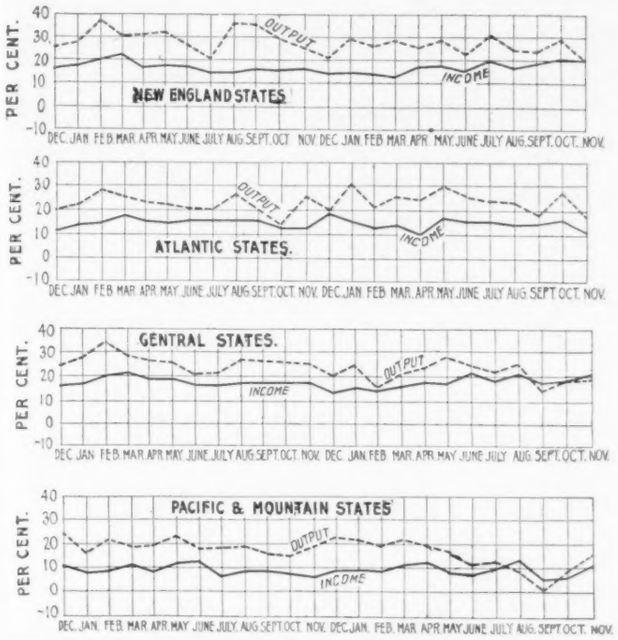
TABLE I—CENTRAL-STATION RETURNS FOR TWELVE-MONTH PERIOD

Month	Percentage of Industry Represented	Income from the Sale of Energy			Kw.-Hr. Output		
		1916	1915	Per Cent Increase	1916	1915	Per Cent Increase
Dec.	62	25,306,000	22,029,000	15.0	1,345,883,000	1,112,280,000	21.0
1917		1917	1916		1917	1916	
Jan.	63	27,408,000	23,969,000	14.4	1,495,829,000	1,180,884,000	26.7
Feb.	63	25,204,000	22,295,000	13.1	1,240,995,000	1,036,014,000	20.0
March	64	23,949,000	20,913,000	14.6	1,409,129,000	1,139,453,000	23.6
April	63	22,927,000	20,165,000	13.8	1,328,092,000	1,085,554,000	22.5
May	62	23,369,000	20,307,000	15.2	1,459,085,000	1,163,483,000	25.3
June	63	23,279,000	20,168,000	15.6	1,407,860,000	1,165,629,000	20.8
July	63	22,768,000	19,680,000	15.8	1,397,482,000	1,159,410,000	20.5
August	63	22,718,000	19,972,000	13.8	1,451,928,000	1,223,373,000	18.7
Sept.	63	23,861,000	20,896,000	14.3	1,376,370,000	1,219,117,000	13.0
Oct.	62	25,630,000	22,248,000	15.4	1,515,501,000	1,273,528,000	18.9
Nov.	49	21,055,000	18,249,000	15.2	1,034,193,000	885,424,000	17.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States (Illinois Excluded)			Percentage of Industry Represented	Pacific and Mountain States		
			1916	1915	Per Cent Increase		1916	1915	Per Cent Increase		1916	1915	Per Cent Increase		1916	1915	Per Cent Increases
INCOME	December	65	$3,203,000	$2,814,000	14.0	66	$11,059,000	$9,348,000	19.6	56	$7,898,000	$6,997,000	13.0	75	$2,987,000	$2,735,000	9.3
	1917		1917	1916			1917	1916			1917	1916			1917	1916	
	January	64	3,181,000	2,762,000	15.1	66	11,400,000	9,874,000	15.6	56	8,081,000	7,013,000	15.2	86	4,602,000	4,020,000	9.5
	February	64	3,039,000	2,686,000	13.1	65	10,249,000	9,021,000	13.6	55	7,471,000	6,530,000	14.4	86	4,284,000	3,926,000	9.2
	March	64	2,861,000	2,547,000	12.3	65	10,203,000	8,902,000	14.7	56	6,692,000	5,754,000	16.5	86	4,193,000	3,780,000	11.0
	April	64	2,756,000	2,357,000	17.0	65	8,601,000	7,765,000	10.7	56	7,132,000	6,094,000	7.0	86	4,282,000	3,821,000	12.1
	May	64	2,640,000	2,253,000	17.2	65	9,495,000	8,118,000	16.9	52	6,912,000	5,914,000	16.9	86	4,173,000	3,883,000	7.5
	June	64	2,641,000	2,290,000	15.4	65	9,281,000	8,017,000	15.7	53	6,718,000	5,563,000	20.9	86	4,480,000	4,174,000	7.4
	July	64	2,634,000	2,205,000	19.4	65	8,919,000	7,687,000	16.1	53	6,690,000	5,643,000	18.6	86	4,482,000	4,110,000	9.2
	August	64	2,352,000	2,025,000	16.2	65	9,021,000	7,881,000	14.5	53	6,910,000	5,718,000	20.9	87	4,819,000	4,270,000	12.9
	September	64	2,811,000	2,362,000	19.0	64	9,139,000	7,963,000	14.7	53	7,232,000	6,177,000	17.1	87	4,636,000	4,355,000	6.4
	October	65	3,049,000	2,523,000	20.8	65	10,598,000	9,107,000	16.3	53	7,361,000	6,259,000	17.6	85	4,571,000	4,315,000	6.0
	November	62	3,118,000	2,608,000	19.6	47	8,076,000	7,250,000	11.4	68	7,082,000	5,884,000	20.3	62	2,722,000	2,458,000	10.7
KW.-HR. OUTPUT	December	65	1916 117,763,000	1915 97,387,000	21.0	66	1916 535,410,000	1915 444,923,000	20.4	56	1916 425,510,000	1915 354,258,000	20.0	75	1916 256,006,000	1915 206,838,000	23.8
	1917		1917	1916			1917	1916			1917	1916			1917	1916	
	January	64	120,211,000	93,163,000	29.1	66	564,699,000	429,432,000	31.5	56	437,923,000	351,335,000	24.5	86	363,094,000	298,990,000	21.4
	February	64	110,114,000	88,324,000	24.7	65	418,407,000	341,877,000	22.5	55	373,988,000	323,158,000	15.8	86	326,891,000	274,079,000	19.3
	March	64	121,434,000	95,515,000	27.2	65	539,028,000	425,376,000	27.0	56	383,046,000	311,841,000	23.0	86	365,541,000	301,721,000	21.3
	April	64	108,968,000	87,237,000	25.0	65	449,445,000	362,752,000	24.0	56	390,103,000	317,505,000	22.9	86	368,557,000	309,474,000	19.1
	May	64	110,991,000	86,675,000	28.3	65	527,004,000	405,719,000	30.3	52	415,795,000	325,986,000	27.7	86	394,554,000	336,541,000	17.3
	June	64	106,817,000	87,345,000	22.4	65	496,784,000	392,905,000	26.5	53	393,770,000	318,316,000	23.6	86	399,622,000	358,727,000	11.2
	July	64	109,399,000	83,451,000	31.4	65	494,965,000	396,538,000	24.8	53	379,087,000	311,931,000	21.5	86	412,635,000	366,237,000	12.7
	August	64	105,848,000	85,113,000	24.5	65	514,254,000	420,806,000	22.3	53	415,966,000	333,549,000	24.7	87	413,462,000	381,353,000	8.3
	September	64	114,339,000	92,319,000	24.0	64	482,112,000	405,070,000	19.0	53	399,480,000	345,953,000	15.5	87	379,221,000	374,685,000	1.4
	October	65	121,497,000	94,685,000	28.3	65	582,893,000	467,135,000	26.9	53	415,381,000	350,561,000	18.5	85	393,735,000	359,661,000	9.5
	November	62	120,248,000	100,596,000	19.5	47	399,350,000	342,287,000	16.9	68	368,490,000	316,479,000	16.5	62	145,011,000	124,453,000	16.5

Taking the actual returns as received and applying them to the estimates for the central-station industry



FIGS. 2 TO 5—CENTRAL-STATION INCOME AND OUTPUT GAIN BY MONTHS IN PER CENT SECTIONALLY

as a whole, the totals indicated for November, 1917, are: Gross revenue, $42,900,000; output sold, 2,110,000,000 kw.-hr.

ELECTRIC FANS FOR FUEL CONSERVATION

By an Agitation of the Air, Which in a Still Room Is of Different "Temperature Strata," Less Heat Is Required

BY CHARLES CATLETT

The statement made above is not strictly true, any more than the statement that an electric fan "cools the air." If an electric fan were started in a closed room, the friction from the fan as well as some of the converted electricity would actually add some heat to the room. But in hot weather an electric fan does cool the body and does give a sensation of coolness by the more rapid evaporation of the visible and invisible moisture which is always forming on the surface of our bodies. In an analogous way the use of an electric fan in winter may, by making more available the heat in a room, make us warmer then we would otherwise be and reduce the total amount of heat which by the ordinary methods of heating must be added to a room.

A moderate-sized room, which at the time was overheated by a low-pressure radiator, was tested with an accurate chemical thermometer and the air was found to be in more or less distinct layers, with a very marked difference in temperature between floor and ceiling:

Distance Above Floor, In.	Temperature, Deg. Fahr.	Distance Above Floor, In.	Temperature, Deg. Fahr.
124	83	44	74
108	80	31	68
93	80	4	66
64	76	0	62

The total amount of heat in the room was sufficient to make the whole room approximately 74 deg., greatly in excess of what is necessary or desirable. A person sitting down would occupy about 50 in. to 54 in. (about 1.3 m.) between his feet and his head inclusive. His feet would be about 4 in. (10 cm.) above the floor, and the center of his body about 26 in. (65 cm.). If he stood up, his head would be between 65 in. and 72 in. (about 2.2 m.). If a person were sitting down in this room, his feet would be at a temperature of about 64 deg., the center of his body about 67 deg. and his head about 75 deg. If he stood up, his head would be about 77 deg. Above his head would be a mass of highly heated air which would be performing no useful service.

It will be noticed that the difference between the temperature of the room at the center of the body and at 9 ft. above the floor was 13 deg. A great many tests showed that when a small 8-in. (20.1-cm.) electric fan was operated diagonally toward the ceiling the temperature near the ceiling was quickly reduced, and that at 26 in. (65 cm.) (the center of the body when sitting down) it was increased so that the difference was reduced to 7 deg. or less. The only way to realize how great is the difference commercially and from a heating standpoint is to remember that three or four degrees mark the difference between comfort and discomfort and between a healthful temperature and an unhealthful temperature.

These conditions are accentuated when a relatively small amount of highly heated air is expected to heat a large building. This heated air rushes to the ceiling. In a room 20 ft. (6 m.) high, for instance, the entire space occupied by a person sitting down would only be a little more than one-fifth of the total height, while the center of the body would only represent a little more than one-tenth. It is perfectly easy to understand that nine-tenths of such a building may be heated greatly above what would be comfortable or desirable, while the occupant of a choir or a pew may be cooler than is necessary for health and comfort.

There can be no question that if an electric fan or some other means were used to agitate and thoroughly mix the air previous to the occupation of the building a more uniform, economical and satisfactory heating would be secured. Anything that would cause a considerable movement or draft while the building was occupied would not be satisfactory, because the draft, by increasing the evaporation from the body, would feel cool. But probably in all large halls which do not have a positive fan system of heating and ventilating the use of an electric fan when heating a building for occupancy would be found a valuable assistance.

Furthermore, as pointed out in the above statement regarding different temperature levels of a still room a constant agitation of the air might easily produce a room temperature that would admit of a smaller heat supply and thereby conserve coal. At the present time, of course, more than the usual importance attaches to this phase of the matter.

If Your Paper Is Late

If your copy of the ELECTRICAL WORLD is late in reaching you, please wait a day or so before writing us that it has been lost. Unparalleled congestion of the mails has caused delays in delivery of all mail matter.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

ECONOMY IN OILS AS PRACTICED IN GERMANY

Notices in Factories and Plants Tell Workmen How to Avoid Wastage in the Use of Lubricating Materials

Notices are now displayed in German workshops and power plants giving hints to the operatives on economy in the use of lubricants. These notices should be valuable in any country. Their provisions are as follows:

Use only closed oil cans, with spouts that will deliver drops, or at most only a thin stream.

Use all lubricating apparatus strictly according to the instructions and put the oil only where it will actually lubricate. If a machine has automatic droppers, shut off the supply while machine is standing.

Do not use cylinder oil on shafting or elsewhere when cheaper oil will answer.

Keep all rubbing surfaces in good condition. Rough surfaces and too-tight boxes consume more oil. Worn and leaky bearings waste oil.

Always use drip pans and arrange to filter and cleanse the oil so caught. It is as good as new.

Collect all greasy waste and wiping cloths, so that the oil may be recovered. Never burn them.

Be careful about using lubricating oil for cooling a bearing. Water will often do as well.

Be careful about using oil for cleaning and polishing. Never clean the hands with oil. A greasy cloth will do as well.

POINTS TO CONSIDER IN THE DESIGN OF TERMINALS

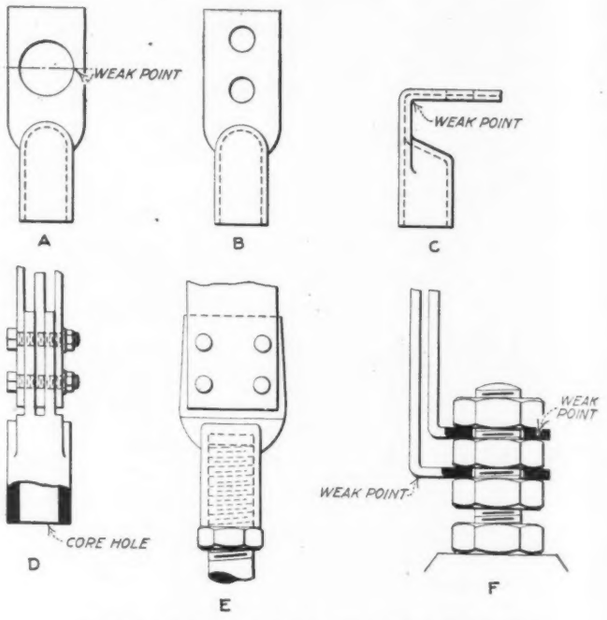
Weak Links That May Gain Inclusion in the Design of Terminal Points in Switching Apparatus Are Pointed Out

BY FERDINAND BECHOFF

The aim of this article is to try to point out some of the weak links to be found in electrical systems, especially in connection with electrical switching apparatus. Experience has shown that many breakdowns have occurred which were due not so much to faulty apparatus, such as oil circuit breakers, etc., as to neglected connecting links between the apparatus and the generator or buses. The fault in such cases is much more with the designer of the switching arrangement than with the manufacturer, because by proper selection of even existing devices the breakdown could have been avoided.

The heating up of terminal points is one of the most common reasons for breakdowns, and this danger becomes more and more pronounced with the installation of large power-plant units and the consequent use of larger oil circuit breakers and other switching devices. It seems that the selection of suitable terminals has not been emphasized enough to the electrical designer of switching apparatus, because so many cases of faulty terminals are still to be found in electrical layouts. While everything is being done to calculate the required amount of copper in regard to conductivity and contact surfaces of the buses, only scant attention is paid to the terminals themselves. Investigation has shown that in most cases the contact surfaces are too small and the fastening bolts too large.

In designing switching arrangements a terminal with a bolt hole as in A should not be considered, as the



WEAK AND STRONG TYPES OF TERMINAL POINTS

contact surface and conductivity in this case have been reduced to a minimum. In B is shown the proper drilling for such a terminal. It is pointed out that care should be taken not to make the fastening bolts larger than ½-in. (1.37-cm.) diameter. The use of brass bolts and nuts is preferable, and all nuts should be locked by means of lock washers or similar means. If the width of the terminal end is 3 in. (7.6 cm.) or more, four bolts should be provided, in order to insure a good contact. The quantity of fastening bolts is one of the most neglected points in terminal design, although offering no difficulties. The general rule for determining the quantity of fastening bolts consists in treating the terminal end in a similar way as a copper bar to be fastened to a busbar, and the design laid down for the latter purpose should be the rule to be followed.

If the holes in the terminals are drilled, they should be slightly countersunk on both sides to remove the burr. Punched terminal holes require a grinding over of the contact surfaces. The design should furthermore avoid as far as possible the use of punched terminals bent at 90 deg., as shown in C. Care should be taken to bend the terminal end with a radius of at least ½ in. (1.27 cm.) to avoid breaking at the bend.

Cast or forged terminals are sometimes preferred to punched terminals, especially in connection with laminated studs and with copper rods or tubes. A threaded

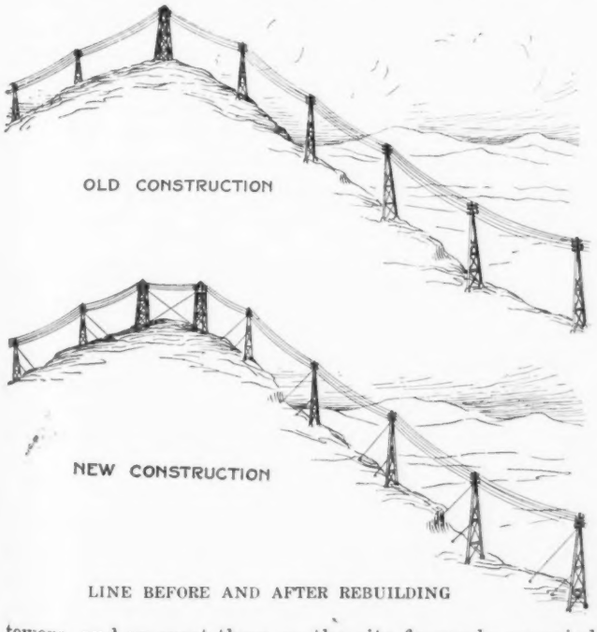
contact, as in E, is better than a soldered connection, and is made safer by the use of a lock nut or similar means. In order to avoid scrapping of cast copper terminals due to blow holes a core hole, as illustrated in D, is often helpful.

Oil and carbon circuit breakers, disconnecting and lever switches with ratings of 2000 amp. and above should be provided with laminated studs, in which case the use of laminated terminals is the most practicable. Even when such large capacity breakers or switches have round studs the laminated terminal can be used to great advantage, as shown in D and E. Copper bars connected in this way to the switch stud give better contact and are easier and cheaper to construct and assemble. Copper bars fastened to the round stud according to the method commonly used, as shown in F, form one of the weak links in electrical installations.

REBUILDING TOWER LINE DAMAGED IN SLEET STORM

Measures Taken to Prevent Recurrence of Failure of Transmission Line Operating Under Severe Climatic Conditions in Mountainous Country

Sixty-five towers in a two-circuit, three-phase, 60-cycle, 33,000-volt line were broken down not long ago by an extraordinarily heavy accumulation of sleet. The line in question traversed a mountainous territory so that it was necessary in making the repairs to carry channel iron into the mountains, rebuild and repair the towers, and re-erect them on the site formerly occupied.



LINE BEFORE AND AFTER REBUILDING

The point at which the failure of the line started was in a four-legged tower on the summit of one of the peaks over which the line stretched. This tower failed in compression, and this, of course, permitted all of the remaining towers to go down. The sketch shows how the line was rebuilt in order to guard against a recurrence of the disaster. A double set of four-legged towers was placed on the summit of the mountain, and each tower on the side of the mountain was guyed toward the summit. The cost of repairing this line with steel at 1914 prices was in excess of $20,000.

DATA FOR ANALYZING BOILER-FEED WATER

Necessary Information Required by the Chemist to Carry Out Properly an Analysis of Boiler-Feed Water

BY T. W. REYNOLDS

Instructions to be followed to insure that any sample of boiler-feed water received by the laboratory is a true specimen were presented on page 99 of the Jan. 12 issue of the ELECTRICAL WORLD. The following lists the information required by the chemist for analyzing the boiler-feed water:

1. Date sampled.
2. Source of sample, such as well, creek, lake, reservoir, etc. Give proper name or owner's name.
3. If a well, state kind, depth and diameter. If a well has been deepened by bore holes or otherwise, give dimensions of both parts.
4. Give suction head of pump. Give suction head when running at full speed.
5. State character of soil and water-bearing stratum.
6. Does sample present the usual appearance of water?
7. Does the water change in appearance at different seasons or after violent storms?
8. Are there any possible sources of pollution, such as coal mines, coal heaps, cinder heaps, factories, slaughter houses, stockyards, stables, sewers, cesspools, privies, foul pastures, refuse dumps, etc.? If there are any, describe fully on the back of the blank, giving distances, directions, relative elevations and character of pollution.
9. Has there been any considerable rain or melting of snow during the two weeks just previous to taking sample?
10. Is the water at present unusually high or low from any cause?
11. Is the quantity satisfactory at all seasons?
12. State distance of the supply from boiler. If a city, give the distance of nearest main from boiler.

CORRECTING POWER FACTOR IN DISTRIBUTION CIRCUIT

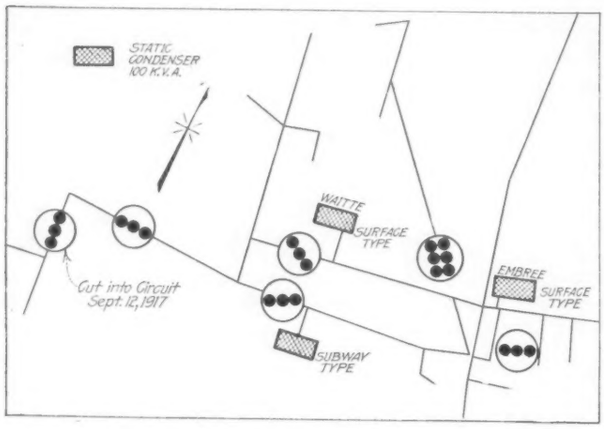
Static Condensers Are Used to Raise Power Factor from 60 per Cent to 90 per Cent on a Heavily Loaded Feeder

BY J. F. DUBOIS
Manager Electrical Department Lynn Gas & Electric Company, Lynn, Mass.

To take on an additional load of 160 hp. in a 550-volt secondary network system, where the primary feeder, switchboard panel and transformers were operating at over capacity, 570 kva., at a power factor averaging 60 per cent and at times running as low as 50 per cent, was the problem which confronted the engineers of this company about three years ago. The company was supplying energy to the neighborhood containing the factory by a 550-volt secondary network, shown herewith in single-line diagram, banks of transformers being connected in at various points.

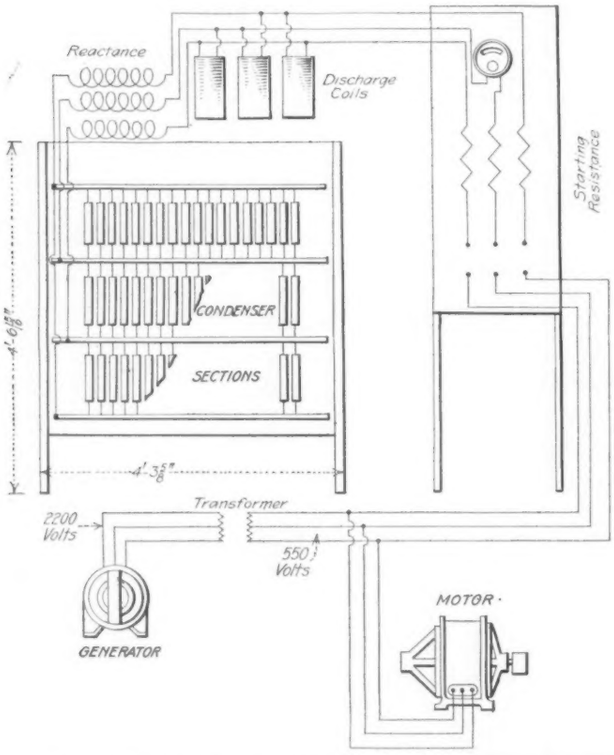
Two courses appeared open—first, to improve the power factor of the operating circuit, and second, to install a new circuit with the necessary transformers, etc. The matter was discussed with engineers of the General Electric Company, who suggested that static condensers might be utilized, although no equipment of this kind for outdoor work had been developed at that time. It appeared that if the second plan of dividing the existing network and installing the necessary transformer and three-conductor cable from the station, to-

gether with switchboard panel and instruments, was followed, the operating conditions would not be improved, but that existing troubles would be increased. The generators would still be supplying the cables and transformers, with the transmission of a large wattless current. On the other hand, by the use of the static



LOCATION OF TRANSFORMER BANKS AND CONDENSERS

condenser the overload on the cables would be reduced. Generator and transformer capacity would be released for other service and the power factor would be improved along the whole system back to the generator. No excitation or operating labor would be required for this form of apparatus.



ARRANGEMENT OF STATIC CONDENSER EQUIPMENT STATIONS

Early in 1915 two static condensers rated at 100 kva. each were installed and connected to the secondary network. Space not being available at the factory first mentioned, one unit of 100 kva. was located in a machine shop across the street. At another point, between banks of transformers shown in circles in the illustration, a portable galvanized-iron building was erected to house the other condenser. The company found itself able to take on this factory of 160 hp. in motors without the addition of a single transformer or the changing of the circuit in any way except in the installation of the condensers. The power factor of the circuit at the station was raised to about 78 per cent. The results were so satisfactory that in the present year another unit, of the subway type, was installed in an ordinary transformer manhole on Munroe Street, Lynn. In this case the cells are inclosed in two tanks, the accompanying reactance being inclosed in a smaller tank about the size of a 5-kva. transformer. An oil switch and contactor are inclosed in another tank, and an ammeter with transfer phase switch and push-button control are placed in a pedestal on the sidewalk. This equipment is working perfectly at present and in a recent test it raised the power factor of the circuit at the station from 60 per cent with the condensers all off to 90 per cent with all the units in, the present load being about 440 kva.

DEVICE FOR TESTING SERIES STREET-LIGHTING CIRCUITS

Homemade Motor-Driven Magneto Used for Testing Circuits—Method of Making Tests to Locate Faults

Many central stations have a rule requiring the testing of series street-lighting circuits during the daytime in order to permit trouble hunting during daylight hours should trouble develop. Often a series circuit will become open-circuited or grounded during the day because of an accident or the carelessness of a patrolman or repair crew, and if the circuit is not repeatedly tested the difficulty will not be discovered until it is time to turn on street lights, at which time the location of the trouble becomes more difficult and a lengthy outage results. It is good practice to test series circuits for open circuits, grounds and crosses at two-hour intervals during the day, particularly after noon.

A device which will be found very useful in the testing of series circuits is a motor-driven magneto. A home-made outfit can be readily rigged up with a telephone magneto and a fan or other small motor ordinarily available about a station. These are attached to a wooden base and mounted near the constant-current transformer panels. A coil spring between the motor and magneto makes a good flexible coupling. A snap switch completes the outfit.

A pair of plugs with insulated handles are attached to the magneto terminals. Then with the plug switches on the series circuits pulled to the outer position the operator may quickly test for open circuits by passing down the panels, touching each pair of plugs with the magneto terminals. In testing for grounds one magneto terminal is grounded and the other is touched to the circuit terminals in succession. The magneto is to be preferred to testing out with lamps, and the motor drive permits the testing to be conveniently done by one man. Crosses are tested for by grounding each circuit. As all secondaries in the system will ordinarily be grounded, a secondary cross will show up in this manner. A primary cross (the primaries being normally ungrounded) will cause a flow of current due to charging or leakage current.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PREPARE HONOR ROLL FOR UNINTERRUPTED SERVICE

Idea Stimulates Competition Between Various Properties of One Organization and Could Probably Be Applied to District Offices Also

An honor roll is being compiled for those Doherty properties which give uninterrupted service. The names on the list are obtained from the weekly reports of the various properties, in which they state the number of interruptions to service during the week just past. Seven companies are on the honor roll for giving perfect service for the two weeks ended Dec. 10. They are the Cumberland & Westernport (Md.) Electric Railway Company, the Durham (N. C.) Traction Company, the Hattiesburg (Miss.) Traction Company, the Lincoln (Neb.) Gas & Electric Light Company, the Lorain County (Ohio) Electric Company, the Massillon (Ohio) Electric & Gas Company, and the Montgomery (Ala.) Light & Railway Company.

This information is sent to all of the properties in the organization and helps to promote competition in the matter of service. The same idea could undoubtedly be applied still further in some degree to district offices of electric light and power properties.

WORK OF NEW-BUSINESS DEPARTMENT IN NEW YEAR

What Will Guide the Sales Activities of Central Stations Engaged in Merchandising Energy and Electrical Goods

In 1918 the central-station man who wants to spend any of his company's money and charge it to capital account will have to show his superiors how that money will come back, not in three, four or five years, as in normal times, but in three, four or five months. That situation changes the aspect of new-business solicitation. In fact, it very nearly reverses what is considered normal procedure in that the salesman will need to become adept at dodging business, especially if it is "on-peak," instead of being alert to secure new contracts.

But, despite this apparently dark outlook, most companies desire to hold their sales organizations together. What are these men going to do? That is the question executives have been asking themselves in the Middle Western States, and within the last few weeks the answer has begun to be apparent. It is, of course, desirable that these men shall apply themselves to some sort of sales work which will increase the company's revenue without increasing its investment. It is, therefore, desirable to increase the consumption of present customers. One way of increasing the business from existing customers is to make it increasingly convenient for them to use the installation they have. Hence among residential customers campaigns will be started to sell "more sockets for more service." Baseboard and other appliance receptacles are the things that make for this increased convenience.

The demand for this sort of thing is already here, as is demonstrated by the following incident: The manager of an electric shop moved into a new apartment in which there was only one baseboard outlet, and that was in the living room. As a condition to signing the lease the landlord was induced to add five more outlets. The manager became acquainted with six other families in the building. When they called at his home and saw the extra outlets they wanted some for their apartments. The landlord, besieged with requests, refused to grant any, and then the tenants had the extra receptacles added at their own expense.

Another means of creating more revenue from existing installations is, of course, by selling more domestic appliances. There will probably be more than the usual number of flatiron campaigns. Other appliances, including ranges, will be pushed in some sections. It is probable that in the larger communities electric ranges will not be pushed so actively, because plant capacity must be conserved for the power business which must be taken on account of government work. All tendencies seem to indicate, however, that electric ranges will be sold in the smaller communities. In the cities the proved labor-saving appliances will probably enjoy ready sale on account of the increasing acuteness of the servant problem.

It seems, therefore, that in 1918 the commercial departments' activities will be centered on selling things which build revenue without increasing demand. Drives to get "more sockets for more service" and appliance campaigns will be the order of the day.

BILLING BY MACHINE MAKES LARGE SAVING

One Lighting Company Found a Saving of 20 per Cent in Billing Expense, Besides a Considerable Shortening of Time

About one year ago the Commonwealth Edison Company of Chicago made a trial installation of twelve Elliott Fisher adding typewriters. With these machines the company handled 20 per cent of its accounts. In using these machines the operator, working directly from the meter-reading book, makes out the bill, posts the ledger, and makes a recapitulation sheet, all at one operation, the entry in the ledger and on the recapitulation sheet being a carbon copy of the bill. On each machine there is a totalizer, or adding machine, on each column. For instance, there is one on both the present and previous wattmeter reading; there is one on the kilowatt-hours used, on the gross bill, discount, net bill, etc., and in addition there is a cross-footing mechanism and total-

izer which subtracts one reading from the other, showing the net difference; which distributes the kilowatt-hours at the various rates and subtracts the discount from the gross, giving the net bill. Fig. 2 is an illustration of the ledger sheet and bill form. All the dates and the name and address are put on the bill in one operation by the addressograph machine.

The recapitulation sheet is used for several purposes: (1) For checking the extension and correctness of the bill; (2) to obtain the total of the monthly billing; (3) to obtain the totals of the number of customers, kilowatt-hours, and other statistics; (4) to furnish an analysis of output and earnings by rate schedules; (5) for drawing off various other statistics.

Recently the company, finding the trial installation satisfactory, purchased eighteen more machines, bringing its total equipment up to thirty machines. From its experience with the machines the company finds that a saving of 20 per cent on billing costs can be effected over the old "longhand" method of billing. When it is stated that each bill issued by the company costs about 16 cents the extent of this saving can be better appreciated.

Further advantages of the mechanical billing system are that the bills look neater and can be turned out faster. It is possible to reduce by one-third the time that formerly elapsed between the date of meter reading and the date of delivery of the bill. It was at first thought that men would be required to operate the machines. Experience has shown, however, that young women with a high-school education can easily and quickly become proficient operators.

STATISTICAL DEPT

DATE ____ BIG CLERK H. BUEHLER COL 1 BOOK

METER READINGS PRESENT	METER READINGS PREVIOUS	K.W.H. CONSUMP	K.W.H. @ FIRST RATE	K.W.H. @ SECOND RATE	K.W.H. @ THIRD RATE	GROSS BILL	CASH DISCOUNT	NET BILL	GROSS BILL	CASH DISCOUNT	NET BILL	COL 1
1982	1934	48	15	15	18	2 94	30	2 64	2 94	30	2 64	#29 AUSTIN
1423	1407	16	15	1		1 56	16	1 40	1 56	16	1 40	#29
1738	1706	32	15	15	2	2 46	30	2 16	2 46	30	2 16	#33
0350	0317	33	13	13	7	2 29	26	2 03	2 29	26	2 03	#33
0995	0982	13	13			1 30	13	1 17	1 30	13	1 17	#103
0505	0496	9	9			90	09	81	90	09	81	#103
0128	0109	19	10	9		1 54	19	1 35	1 54	19	1 35	#111
0074	0051	23	20	3		2 18	23	1 95	2 18	23	1 95	#111
0884	0853	31	19	12		2 62	31	2 31	2 62	31	2 31	
0968	0944	24	20	4		2 24	24	2 00	2 24	24		#126
1065	1042	23	21	2		2 22	23	1 99	2 22			#127
0753	0733	20	18	2		1 98	20	1 78			50	#131
1043	0990	53	16	16						32	2 51	#131
0383	0365	18							2 36	28	2 08	#133
1453	1416					2 76	34	2 42	2 76	34	2 42	#133
2380				16	4	2 68	32	2 36	2 68	32	2 36	#100
		11	11			1 10	11	99	1 10	11	99	#101
0697	0487	22	18	4		2 04	22	1 82	2 04	22	1 82	#101
0519	0502	17	17			1 70	17	1 53	1 70	17	1 53	#103
82103	79971	2132	949	563	520			144 91			144 91	

SHEET No. ____ DAY 8 S X DISTRICT 7 MONTH APR DATE 4 13 1917

SHEET No. ____ DAY 8 S X DISTRICT 7 MONTH APR DATE 4 13 1917

FIG. 1—RECAPITULATION SHEET OF COMMONWEALTH EDISON COMPANY

WATT-METERS: No. 35789, Size 5-110, Make K 4

MAXIMUM INDICATORS: Size, No.

BILLING INSTRUCTIONS: Schedule A, Rider, Installation Order 253769

NAME AND ADDRESS: JOHN SMITH, FL 2, 2141 S MARYLAND AVE, 20 / 8

MAILING ADDRESS:

CONNECTED LOAD: 14 6 / 50 60

CLASS APT SYSTEM ALT METER CONSTANT 1

DEPOSIT: Cert. No. | Date | Amount | Date Refunded

DATE	METER READINGS PRESENT	METER READINGS PREVIOUS	K.W.H. CONSUMP	K.W.H. @ FIRST RATE	K.W.H. @ SECOND RATE	K.W.H. @ THIRD RATE	GROSS BILL	C. D. DISCOUNT	NET BILL	REMARKS	DATE PAID	CASH	REBATE GRANTED	CASH APPLIED AS DISCOUNT	BALANCE DUE
JAN 23 1917		4347	45												
FEB 21	4404	4347	57	16	16	25	3 31	32	2 99		MAR 5	2 99			
MAR 22	4444	4404	40	16	16	8	2 80	32	2 48		APR 6	2 48			
APR 21	4504	4444	60	16	16	28	3 40	32	3 08						

SAVE time by telephoning us as soon as you have decided **when** and **where** you will move.
Tell us **when** to read and disconnect meter at old address and **when** and **where** to make the new connection.
COMMONWEALTH EDISON COMPANY
72 West Adams Street

Ask to see the "HILO" ECONOMICAL TUBE DOWN LAMP

Form A 181 500m 0-1-17

ELECTRIC LIGHT BILL DATE MAR 3 1917

METER READINGS		Total Consumption in Kilowatt Hours	First 30 Hours Use of Maximum 2¢ per K.W.H.	Second 30 Hours Use of Maximum 1½¢ per K.W.H.	Excess Over 60 Hours Use of Maximum 1¢ per K.W.H.	GROSS BILL	Discount of 1¢ per K.W.H. on Bills and on Portions only if Paid on or Before MAR 13	NET BILL
FEB 21	JAN 23							
4404	4347	57	16	16	25	$ 3 31	32	$ 2 99

TO COMMONWEALTH EDISON COMPANY
GENERAL OFFICE, EDISON BUILDING, 72 W. ADAMS STREET, CHICAGO
OFFICE HOURS: FROM 8:30 A.M. TO 5:30 P.M. SATURDAY 8:30 A.M. TO 1 P.M.

THIS BILL CAN BE PAID AT THE FOLLOWING PLACES WITHOUT ANY FEE FOR COLLECTION:

GENERAL OFFICES, 72 W. ADAMS ST. BRANCH OFFICE, 411 So. PEORIA ST.
ELECTRIC SHOP, JACKSON & MICHIGAN BLVD. 6001 LOWE AVE.
BRANCH OFFICE, 5163 So. CHICAGO AVE. 5948 W. LAKE ST.
3127 LOGAN BLVD. 2748 LINCOLN AVE.
BRANCH OFFICE, 4823 BROADWAY

AFTER 10 DAYS THIS BILL CAN BE PAID ONLY AT THE ABOVE ADDRESSES

FOR A FEE OF FIVE CENTS this bill can be paid at Money Order Agencies of the American or National Express Companies, that saving you time, trouble and extra car fare. Money Order Agencies of these Companies usually with druggists will be found in your immediate neighborhood—LOOK FOR THE SIGN. Always see that you obtain the EXPRESS COMPANY'S RECEIPT stamped on your bill when paid at these Agencies

CUSTOMER'S RECORD OF PAYMENT—Paid by Check No. ____ Money Order No. ____ Date ____

JOHN SMITH 20
FL 2 7
2142 S MARYLAND AVE 0

COMMONWEALTH EDISON COMPANY
ELECTRIC LIGHT BILL

IF YOU PAY BY CHECK OR MONEY ORDER, PLEASE DETACH THIS STUB, DEAL WITH CHECK OR MONEY ORDER TO 72 W. ADAMS ST., AND RETAIN THIS OTHER PORTION OF THE BILL AS THE CANCELLED CHECK IS AMPLE RECEIPT

GROSS BILL	Discount if Paid on or Before MAR 13 1917	NET BILL
$ 3 31	$ 32	$ 2 99

JOHN SMITH 20
FL 2 7
2142 S MARYLAND AVE 0

FIG. 2—LEDGER SHEET AND BILL OF COMMONWEALTH EDISON COMPANY

COMMERCIAL AND FACTORY LIGHTING CAMPAIGN FIGURES

Fixtures Sold Total 5600, of a Merchandising Value of $89,600 and a Wattage Increase of 452 Kw.

The new-business department of the Doherty organization inaugurated a campaign for additional commercial and factory lighting on March 1 of last year, terminating Dec. 1, in charge of R. J. Kennedy, illumination specialist, and a report of the accomplishments was recently made public. The result was so successful that Mr. Kennedy will soon start on a similar tour of the Southern properties.

The number of new fixtures installed because of this campaign in nine properties was 5600, of a merchandising value of $89,600, and with a wattage increase in three properties—Toledo, Massillon and Alliance, Ohio—of 452 kw. These installations were all in excess of 300 watts. The table gives the detailed figures.

LIGHTING FIXTURES INSTALLED IN NINE MONTHS' CAMPAIGN

Company	Number of Fixtures	Merchandising Value
Toledo	4,000	$64,000.00
Massillon	500	8,000.00
Alliance	100	1,600.00
Joplin	200	3,200.00
Sedalia	100	1,600.00
St. Joseph	400	6,400.00
Salina	100	1,600.00
Hutchinson	100	1,600.00
Athens	100	1,600.00
Total	5,600	$89,600.00

The new-business department also announced comparative figures for the first eleven months of 1917. In this period appliance sales totaled $1,653,619, as compared with $1,127,830 for the first eleven months of 1916. With December to hear from, it is estimated that 1917 will show a total of $1,800,000.

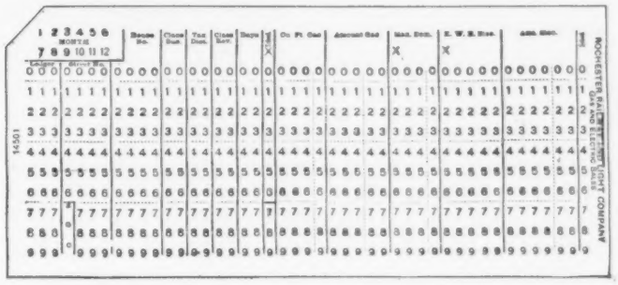
METHOD EMPLOYED FOR ANALYZING OF BUSINESS

Rochester Company System for Figuring Average Rates and Studying Income from Different Classes of Customers

The Rochester (N. Y.) Railway & Light Company has in force a system of account classification which enables the management to study closely single accounts. A large 11-in. by 8½-in. (28-cm. by 21.6-cm.) ruled sheet, as shown herewith, is used each month. The classification is in seventy separate divisions. Each division has an index number or code number for use with a tabulating machine. The cards, like the one shown, are punched with the numbers. The desired information is taken off the sheet by a single sorting of the cards and one tabulation. At the present time the company is making twelve different analyses of its sales from this single card.

As will be noted from the income analysis sheet, each division of accounts is grouped according to single gas and single electric accounts and to combination accounts. By showing the number of such accounts and the total income, the average bill per single account in any division can be determined. It is also of service in working out average rates for particular classes of business.

These analyses show many interesting things. For instance, residential business, from previous reports,



TABULATING CARD USED BY ROCHESTER RAILWAY & LIGHT COMPANY

has shown the company's income to be much higher per account where the consumer uses gas for fuel and electricity for lighting than where the consumer uses gas for both fuel and lighting.

ROCHESTER RAILWAY & LIGHT COMPANY
ANALYSIS OF INCOME
Month of.....191..

	Single Gas Accounts		Single Electric Accounts		Combination Accounts		
						Gas	Electric
	No.	Amount	No.	Amount	No.	Amount	Amount
00. Apartment houses							
1. Residences							
2. Offices							
3. Department stores							
4. General corner-store lighting							
5. Drug stores							
6. Churches							
7. Public garages							
8. Private garages							
9. Theaters							
10. Eleemosynary institutions							
11. Restaurants							
12. Saloons							
13. Hotels							
14. Breweries							
15. Printing establishments							
16. Clothing manufacturers							
17. Machine shops							
18. Contractors							
19. Cold-storage plants							
20. Summer resorts							
21. Bakeries							
22. Shoe manufacturers							
23. Candy manufacturers							
24. Wholesale establishments							
25. Woodwork							
26. Manufacturing buildings							
27. Stamping works							
28. Greenhouses							
29. Flour mills							
30. Electric roof signs							
31. Optical goods							
32. Paper-box manufacturers							
33. Colleges and private schools							
34. Elevator service							
35. Miscellaneous manufacturing businesses							
36. Outside decorative lighting							
37. Photo manufacturers							
38. Public buildings							
39. Clubs							
40-41. Municipal lighting, general fund							
42-43. Municipal lighting, additional							
44. Fire boxes							
45-55. Railroad corporations							
56-57. New York State Railways							
58-68 & 71. Electric corporations							
69-70. Railroad & Lighting Co							
Totals							

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Extinguishing Fires in Large Totally Inclosed Generators and Motors.—M. A. SAVAGE.—This article recommends the use of steam for extinguishing fires in windings of large motors and generators where the construction permits of its application. The results of tests show that steam is quite as effective as other substances, such as carbon tetrachloride and carbon dioxide, and is free from their objectionable features.—*General Electric Review*, January, 1918.

Electrical Laboratory Apparatus for Educational Institutions.—J. J. LAMBERTY.—For the instruction of engineering students college laboratories should be equipped with practically all types of electrical apparatus, but the cost of separate units of each type is prohibitive for most institutions. This difficulty has been largely overcome by the apparatus described in this article, which incorporates in one design, by substitution in some cases of interchangeable rotors, a great variety of machines. For instance, the alternating-current generator may be operated as a synchronous motor, a squirrel-cage induction motor, a phase-wound induction motor or a frequency changer by using the proper one of three rotors. Similarly the synchronous converter may be used as a direct-current generator, an alternating-current generator, a direct-current motor, a synchronous motor or an inverted converter.—*General Electric Review*, January, 1918.

Lamps and Lighting

An Oxygen-Filled Tungsten Lamp.—According to a recent German patent, beneficial results follow the burning of a tungsten filament in an atmosphere of oxygen at low pressure. This, it is claimed, prevents discharges through chlorine vapors evolved from anti-blackening materials introduced into the bulb. The oxygen at low pressure does not appreciably attack the incandescent tungsten filament, but in the colder regions of the lamp vaporized tungsten is oxidized to tungsten trioxide. The pressure of the oxygen present is, however, extremely low, being less than 0.005 mm. of mercury. The small amount of oxygen initially introduced into the lamp would be quickly used up, and the author therefore proposes to include within the bulb certain oxygen-yielding substances, such as the oxides, nitrates, chlorates, etc., of suitable metals. Manganese oxide in small quantities is found very beneficial.—London *Illuminating Engineer*, November, 1917.

Transformation of Tungsten Crystals Into Filaments for Incandescent Lamps.—By a new method tungsten filaments, to which a small quantity of oxide of thorium is applied, can now be made without drawing, laminating or hammering. The article gives a brief description of how they are fabricated from crystals—a method subject to many German patents.—*Revue Générale de l'Electricité*, Dec. 22, 1917 (abstracted from *Elektrotechnische Zeitschrift*, April 26, 1917.)

Testing Arc Lights Under Pressure.—Wilhelm Matthiesen, a German electrical engineer, recently conducted a series of tests with arc lights under different pressures of the two gases composing the atmosphere (oxygen and nitrogen). The first tests showed that the brilliancy of the light increases with increased pressure, while the specific consumption decreases, although the total amount of energy used is greater. The brilliancy itself, as well as the rate of increase, depends also upon the kind of salts mixed with the carbons. The second series of tests showed that the brilliancy of the arc can be increased by simply increasing the pressure of the gas, without increasing the consumption of energy. The rate of increase depends upon the gas used (air, oxygen or nitrogen). If calcium fluoride is mixed with the carbons and the resulting gases are permitted to accumulate, the brilliancy of the arc diminishes rapidly.—*Schweizerische Bauzeitung*, Dec. 22, 1917 (abstracted from *Elektrotechnische Zeitschrift*).

Generation, Transmission and Distribution

Report of the Advisory Committee on Brown Coal (State of Victoria), September, 1917.—Among the conclusions reached by the committee as the result of its investigations are the following: With present prices the brown-coal fields offer a supply of much more economical fuel than black coal for the production of electrical energy. The demand for electrical energy in Melbourne is sufficient to form the nucleus for an industrial electrical supply system. For a demand of 50,000 kw. delivered at Melbourne at 20,000 volts the total costs per unit supplied from power houses situated respectively at Melbourne, burning black or brown coal, and at Morwell, burning brown coal, are as follows:

	Total Costs per Unit at a Load Factor of 43.2 per Cent, Pence	Ratio
Power house in Melbourne using—		
Newcastle coal	0.353	1.000
Wonthaggi coal	0.348	0.986
Brown coal (Altona)	0.328	0.929
Power house at Wonthaggi using black coal	0.350	0.991
Power house at Morwell using brown coal	0.267	0.756

Electricity Supply Restrictions in Germany.—It is reported from Berlin that the Imperial Coal Commissioner issued an order on Nov. 2, 1917, placing an immediate restriction on the electrical consumption of both customers of electric supply undertakings and persons or organizations who possess their own generating plants. The consumption is limited to 80 per cent of that which prevailed in the corresponding month in 1916, although the commissioner reserves the right of curtailing the consumption by more than 20 per cent in particular cases. The restriction also applies to establishments engaged on war work, although preferential treatment can be meted out in exceptional cases. Consumers on a small scale are exempt from the restrictions, provided that their individual use does not exceed

250 kw.-hr. per annum, but the communal authorities are permitted to fix a lower limit. New connections and extensions of existing connections can only be made on obtaining special consent. It is stipulated that consumers who receive a supply from a public utility must pay an increase of 12 cents for every kilowatt-hour used in excess of the fixed limit. If, despite special warning, consumers do not restrict their consumption in the prescribed manner, they will be liable to imprisonment for a period up to one year, or a fine of up to $2,500. Sixty truckloads of coal a day will shortly be saved in connection with the electric lighting of Berlin by erecting an overhead high-pressure transmission line between Wittenberg and Berlin, which will now be fed by the Zschornewitz-Piesteritz line, supplied from the Zschornewitz (lignite) power station, the generating station for works for the fixation of nitrogen. The overhead line will be made of aluminum-covered iron, and the work is being carried out by the A. E. G.—London *Electrical Review*, Nov. 22, 1917.

The Swiss Law Concerning the Utilization of Hydraulic Power.—G. TOCHON.—An examination by a French lawyer into the law concerning water power that became effective in Switzerland Jan. 1. Like the new Italian law, it tends to centralize all public utilities occupying water sites and to bring under public control the reserve energy contained in rivers and falls. The predominance of the general interest over private interests is insisted on. Each canton has, however, the right to dispose of its own water powers, subject to the broad policy prescribed by the confederation. Only in two cantons have private rights been predominant in the past. It would perhaps be exaggerated, the author says, to speak of the state as having seized the sources of hydraulic power; it is rather a matter of stricter control within just limits which are such as not to prevent development.—*Revue Générale de l'Electricité*, Nov. 24, 1917.

Traction

Railroad Electrification. — A. BARBAGELATA. — The writer holds: (1) That at present it is absolutely necessary for Italy to push railroad electrification in every manner; (2) that electric traction may be economically extended even to secondary lines, if they are treated like suburban lines, with light and frequent trains; (3) that the three-phase, 16-cycle system adopted in Italy, which has given excellent results on the Giovi lines, is no longer the best, and that direct current at high tension should be substituted.—*L'Ettrotecnica*, Dec. 25, 1917.

Installations, Systems and Appliances

Relay Protective Devices.—C. J. MONK.—This paper describes the various types of relays used on the Rand Mine & Power Supply Company and the Victoria Falls Power Company systems, with details of their operating characteristics and results achieved with these automatic devices. There are something like 400 relays in operation on the systems.—*Transactions of the South African Institute of Electrical Engineers.*

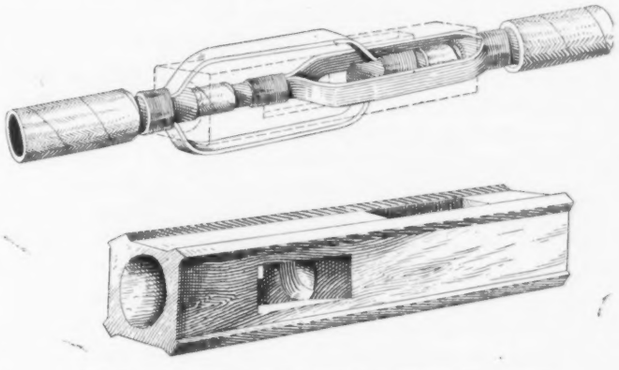
Ironclad Switchboard.—Description of high-tension ironclad distribution boards and truck-type cellular switchboards equipped with oil switches, etc.—London *Electrical Times*, Dec. 27, 1917.

Examples of Electrically Driven Cranes.—H. H. BROUGHTON.—The author points out in this article the great importance of using machinery in place of unskilled labor. Examples are given of special plants for handling materials, such plants including shipyard cranes, steel works cranes and bridge tramway plants.—London *Electrician*, Dec. 14, 1917.

Belt Shipping Plants.—F. G. MITCHELL.—Attention is drawn to the great advantages of the belt conveyor for conveying coal and ore in bulk. A detailed account is given of an interesting plant at Durban. This plant is not limited by mechanical difficulties, and any disadvantages do not increase, but rather the reverse, as the output is increased.—London *Electrician*, Dec. 14, 1917.

Wires, Wiring and Conduits

Transposition Joint for Split-Conductor Cables.—Description of a method for providing transposition joints in three-core split-conductor cables to balance the impedances of the inner and outer conductors. It involves the use of a hard-wood separator for each conductor. After stepping back the lead and insulation in the usual way, two short lengths of braided copper of a total section equal to one of the conductors are bound and sweated to each inner conductor; the two pieces of copper braid are then threaded through apertures provided in the hard-wood separators, the ends of the inner conductors being separated from one another by a diaphragm left solid in the center of the wood block, and are bound and sweated to the outer conductor of the adjacent length. The braid lies loosely along shallow grooves on the outside of the separators, expansion and contraction of the conductors thus being also provided for. The joint on each phase is then surrounded by a paper tube, the three tubes of the completed joint being bound together, centralized by means of spreaders, and the whole inclosed in a lead sleeve and filled up solid with insulating compound in the usual manner. Joints made in this manner by jointers having no special knowledge of the requirements of split-conductor joints have withstood 15,000 volts between split conductors for five minutes and 100,000 volts between phases and between phases and earth for fifteen minutes, at a temperatpre of 176 deg. Fahr.—London *Electrical Review*, Jan. 4, 1918.



JOINT FOR THREE-CORE SPLIT-CONDUCTOR CABLE

Electrophysics and Magnetism

New Radiator Type of Hot-Cathode Roentgen-Ray Tube.—W. D. COOLIDGE.—The article is descriptive of the new radiator type of hot-cathode Roentgen-ray tube developed for military use. The essential feature of this tube is the target of large heat capacity (provided

with an external radiator) of such composition that the focal spot will not at any temperature emit electrons. The tube therefore is self-rectifying, which makes it feasible to operate the tube directly from the terminals of a high-tension transformer. A description of a simple and effective lead-glass protective shield is included.—*General Electric Review*, January, 1918.

Electric Conductivity of Mica.—EDOUARD BRANLY.—Abstract of a paper read before the French Academy of Sciences embodying the results of experiments on mica with particular reference to its use as an insulating material in wireless telegraphy. A leaf of mica about 0.003 mm. thick was placed between two metallic disks. In a very short time its electric resistance to a continuous current became of negligible value when the applied emf. was less than 0.004 volt and the mechanical pressure was not more than 1 cm. of mercury. A descriptive summary of the apparatus employed is given, together with data on the variations of conductivity in mica as apparently influenced by the diameter of the minute holes discoverable by means of polarized light.—*Revue Générale de l'Electricité*, Nov. 24, 1917.

United States Magnetic Tables and Magnetic Charts for 1915.—D. L. HAZARD.—As its name implies, this report gives terrestrial magnetic data obtained by the United States Coast and Geodetic Survey for 1915.—*Department of Commerce Special Publication No.* 44.

Chromium Steel for Magnets.—Owing to the commandeering of tungsten for military purposes, German electricians found themselves without tungsten for their magnet steels early in the war, and experiments on the use of chromium in the place of tungsten, which had already been projected before the war, were accelerated. From investigations conducted by the Reichsanstalt chromium steels which have undergone suitable heat treatment do not rank below tungsten steels on an average. The very best magnetic chromium steels, however, are not equal to tungsten steels. Technically, chromium steels would thus appear to be quite satisfactory, while for special researches their further improvement is desirable.—London *Engineering*, Jan. 4, 1918.

Miscellaneous

Utilization of Pulverized Coal.—HENRY G. BARNHURST.—After calling attention to the fact that the use of pulverized coal for heating purposes is not new, 30,000,000 tons to 50,000,000 tons having been used to date in cement mills alone, the author mentions some of the characteristics that are desirable in coal in order that it may be burned satisfactorily in this form. Large deposits of lignite, quantities of coke breeze and millions of tons of silt or waste coal are available for burning in the pulverized forms. The author then goes on to explain the degree of fineness to which coal should be crushed before drying, the best methods of drying, extracting pieces of iron, the care which should be exercised in pulverizing and storing the fuel and how it may be conveyed to the place of usage. The power required in a first-class pulverized-coal plant per net ton of coal handled is in the neighborhood of 17 hp.-hr. per ton produced. Generally speaking, the repair expenses run 5 cents to 7 cents per net ton handled. With coal carrying 5 to 10 per cent moisture about 25 lb. to 35 lb. (11.3 kg. to 15.9 kg.) of coal has to be burned to dry a ton. When handled in large quantities 50 tons to 100 tons and upward can be pulverized and delivered to the furnaces at a cost of 20 cents to 50 cents a ton. Generally speaking, an ideal plant with a capacity of 100 tons of pulverized coal daily will cost, with the prescnt prevailing high prices, in the neighborhood of $300 to $400 per ton of coal pulverized. The cost of a plant for 250 tons daily capacity of pulverized coal will be from $250 to $300 per ton.—*Journal of Cleveland Engineering Society*, November, 1917.

Report of British Coal Conservation Committee.—The sub-committee of the reconstruction committee in Great Britain recommends that the present inefficient electric service system in that country be superseded by a comprehensive system divided into about sixteen districts, in each of which there shall be one authority dealing with all generation and main distribution. Sites suitable for electric generating purposes should be chosen on important waterways and preferably outside, not inside, towns. Plans should be prepared for the construction immediately after the war on these sites of large super-power plants capable, first, of supplying energy to a comprehensive electric power distribution system and, secondly, of supplying electrical energy at lowest possible price for all processes and manufactures. Such plants should be designed so that, as methods are perfected for extracting by-products from fuel before using it for the purpose of production of electrical energy, the by-product plant can be combined with the power plant. Power available from surplus gas or waste heat should be turned into electrical energy in local plants, which should feed into the main distribution system. Coal which does not warrant transportation away from the mine should be used at the spot for power generation. With a view to carrying out this policy, a board of electricity commissioners should be appointed with the following powers: (a) To stop the extension or multiplication of uneconomical stations for public supply; (b) to arrange for the handing over on equitable terms of the generation, transmission and main distribution systems in each of the areas into which the country is to be divided; (c) to standardize for each area the frequency and voltage of the main transmission and distribution systems; (d) to select for each area authorities to work under adequate control as regards limitation of dividends, etc. Alternative types of electric service organizations are described in an appendix. In reference to these alternative types the sub-committee emphasizes the need of initiative and resource in the management of electric service organizations and the freedom of range and keenness which are distinctive of private enterprises, as such things are highly conducive to the best success.—London *Electrician*, Dec. 28, 1917.

Hardening of Aluminum Bronze.—According to advice from Europe, copper-aluminum alloys, combined with small quantities of iron, silica, etc., can be made to equal in hardness Bessemer steel with 0.35 per cent carbon. In order to obtain these degrees of hardness, temperatures of 800 deg. C. are required, whereby 100 deg. to 260 deg. (Brinell test) is reached. Bearings made of such aluminum bronze have proved satisfactory with shafts turning at 20,000 r.p.m.—*Schweizerische Bauzeitung*, Dec. 22, 1917 (abstracted from *Z. d. V. D. I.*).

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

STUDY OF THE TARIFF BY ASSOCIATED MANUFACTURERS

General Committee Is Co-operating with Section Committees—Separate Treatment of Electrical Apparatus and Supplies Desired

Steady progress is being made by the tariff committee of the Associated Manufacturers of Electrical Supplies in its work of studying tariff conditions affecting the electrical manufacturing industry.

At a recent meeting of the committee there were also present a number of members of section sub-committees on tariff.

The chairman, John J. Gibson, Westinghouse Electric & Manufacturing Company, stated that in each section committees were preparing to act along the general lines proposed.

B. E. Salisbury, Pass & Seymour, Inc., felt that one point to be considered was administrative features of the tariff law. Mr. Salisbury stated that so far as he knew the tariff schedules on electrical devices were very incomplete and that it would be necessary to outline some plan especially applicable to the wants of the electrical industry. He also felt that the duties now assessed on an ad valorem basis should be based on the market price. After extended discussion the following resolution, which was presented by Mr. Salisbury, was passed:

"Resolved, That it be the sense of this meeting that the value of all electrical commodities now assessed on an ad valorem basis should be determined by the market price of those commodities in this country rather than the market price in the country of origin."

One member brought up the desirability of some tariff legislation to overcome the condition that foreign makers had copied the design of many devices of electrical supplies, which they were bringing into some portions of this country and selling in direct competition with the home markets, although these various devices had not yet been approved by the Underwriters' Laboratories.

F. S. Sells, Diehl Manufacturing Company, emphasized his opinion that at this time it would be impracticable to develop figures representing the amount of tariff protection needed on any particular lines, and this opinion was concurred in by all present. It was thought necessary for the section tariff committee to make the study which had been requested and complete it so that the committee could have it approved by the various sections.

In the meantime the general committee should take steps to get into touch with the United States Tariff Commission, with the purpose of recommending the following results:

First—That the electrical industry be recognized so that, if thought advisable, it would secure separate treatment of its apparatus and material instead of having them mixed in with the apparatus and material of other industries.

Second—In order that the electrical industry might have a voice at the present time in the matter of the revision of the administrative sections of the tariff law.

It was the sense of the meeting that the general tariff committee should secure from the board of governors authority to employ a tariff expert.

Chairman Gibson called attention to the resolution passed by the board of governors broadening the duties of the general tariff committee so that they would include questions in regard to export as well as import. Authority has been given by the governors to change the name from the tariff committee to "international trade committee" if this would be desirable.

I. E. S. TO DISCUSS THE CURTAILMENT OF LIGHTING

Preston S. Millar to Present Paper at Special Meeting in New York on Feb. 14—General Discussion Planned

A special meeting of the Illuminating Engineering Society will be held at 8.15 on Thursday evening, Feb. 14, in the Engineering Societies Building auditorium, New York, to discuss lighting curtailment.

A paper will be presented by Preston S. Millar, general manager Electrical Testing Laboratories and chairman of the committee on war service of the Illuminating Engineering Society. The author will present figures dealing with coal consumption, including the coal employed for lighting throughout the country and the amount which may be saved, methods of accomplishing the results expected through the curtailment of lighting, present status of artificial lighting used for various purposes and other pertinent facts.

The following is a list of those who have been invited to speak personally or send a representative to discuss this question: Albert H. Wiggin, Federal Fuel Administrator for New York; Harry T. Peters, member of the conservation and advisory committee of the New York State Fuel Administration; John W. Lieb, chairman National Committee on Gas and Electric Service; R. E. Enright, Commissioner of Police; Nicholas J. Hayes, commissioner of Water Supply, Gas and Electricity, New York; Dr. Colman W. Cutler, chairman illumination committee, National Committee for the Prevention of Blindness; Ernest T. Trigg, chairman committee on coal conservation, United States Chamber of Commerce; Dr. Edward B. Rosa, acting director National Bureau of Standards; L. B. Marks, chairman national lighting committee, United States Committee of Labor; Frank W. Smith, chairman lamp committee, National Electric Light Association. Representatives of the American Institute of Electrical Engineers and American Gas Institute are also expected to participate.

Effect of Garfield Fuel-Saving Order

Statements to the "Electrical World" Supplementing Those Published Last Week

BUFFALO GENERAL ELECTRIC COMPANY

OUR load has been reduced 30 per cent. Total kilowatt-hour output per day has been reduced 17½ per cent; 60 per cent of our output is steam-generated and the balance, 40 per cent, hydro power. Our coal saving amounts to about 225 tons each twenty-four hours.

NEW YORK EDISON COMPANY AND UNITED ELECTRIC LIGHT & POWER COMPANY, NEW YORK

The reduction in output of the two companies together for the five days of the Garfield order—Jan. 18 to 22, inclusive—represented an average of 21¼ per cent. The estimated saving in coal for the full period is approximately 3000 tons.

PUBLIC SERVICE ELECTRIC CO., NEWARK, N. J.

During the five days of the so-called Garfield order the output was curtailed very materially. Our normal load is approximately 125,000 kw., and on the first day of the order this was reduced to about 40,000 kw., which load was somewhat increased later on owing to exemptions granted in specific cases. Roughly speaking, it might be said we were operating on a less than 50 per cent basis during the five days the order was in force.

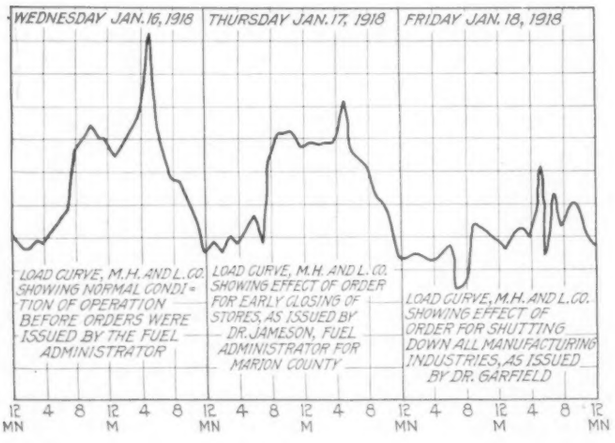
INDIANAPOLIS LIGHT & HEAT COMPANY

Our peak load prior to the Garfield order ran about 17,000 kw., with 230,000 kw.-hr. output for the day and a consumption of 1,050,000 lb. of coal. The effect of the Fuel Administration order was to reduce the peak to 9129 kw., with a total output of 113,000 kw.-hr. and a consumption of 696,000 lb. of coal.

MERCHANTS' HEAT & LIGHT COMPANY, INDIANAPOLIS

We inclose typical load curves which show the comparative effects for three days: Wednesday, Jan. 16, 1918, load curve representing normal condition of operation before any orders were issued by the Fuel Administrator; Thursday, Jan. 17, load curve showing the effect of the local order closing stores at 4.30 p. m. as issued by Dr. Jameson, Marion County Fuel Administrator; and Friday, Jan. 18, load curve showing the effect of order shutting down all of the manufacturing industries as issued by Dr. Garfield.

These curves show graphically the conditions to be expected on our system as a result of the Fuel Administrator's order, and it is evident that it will mean a considerable reduction in our gross receipts due to the decreased electrical output in kilowatt hours. At this time we are not prepared to give definite estimates of the actual saving of fuel that may result. The radical change in the character of our load makes it hard to figure the saving accurately.


WEDNESDAY JAN. 16, 1918
THURSDAY JAN. 17, 1918
FRIDAY JAN. 18, 1918
LOAD CURVE, M.H. AND L. CO. SHOWING NORMAL CONDITION OF OPERATION BEFORE ORDERS WERE ISSUED BY THE FUEL ADMINISTRATOR
LOAD CURVE, M.H. AND L. CO. SHOWING EFFECT OF ORDER FOR EARLY CLOSING OF STORES, AS ISSUED BY DR. JAMESON, FUEL ADMINISTRATOR FOR MARION COUNTY
LOAD CURVE, M.H. AND L. CO. SHOWING EFFECT OF ORDER FOR SHUTTING DOWN ALL MANUFACTURING INDUSTRIES, AS ISSUED BY DR. GARFIELD
12 MN 4 8 12 M 4 8 12 MN 4 8 12 M 4 8 12 MN 4 8 12 M 4 8 12 MN

COLUMBUS RAILWAY, POWER & LIGHT COMPANY

As compared with the corresponding days of the preceding week our output was reduced as follows: During the five days of reduced operation covered by the Garfield order: Friday, 29.6 per cent; Saturday, 23.9 per cent; Sunday, 18.7 per cent; Monday, 31.3 per cent; Tuesday, 18.0 per cent.

Taking the five-day period as a whole, the decrease in output as compared with the five corresponding days of the preceding week was 24.6 per cent or 430,000 kw.-hr. During this period our peak hour was decreased as follows on the various days: Friday, 8300 kw.; Saturday, 4500 kw.; Sunday, 3100 kw.; Monday, 6700 kw.; Tuesday, 3250 kw.

To the Citizens of Columbus:

THIS COMPANY is today in a more critical situation as regards fuel supply than ever before, having in fact only enough coal on hand to produce its normal output for a period of two days.

The large savings in fuel, resulting from the five-day suspension order of the Fuel Administration, have been more than offset by the failure of the railroads during the severe weather to deliver coal to meet even the reduced demands.

A suspension of electric service is probable if not inevitable. You can postpone that suspension by using less current.

The Columbus Railway Power & Light Company

During the period covered by the Garfield order railway service was reduced considerably and extreme efforts were made to induce the users of electrical energy to close or reduce their requirements to a minimum. All of our lines, however, were energized as usual, we taking the position that the responsibility for obeying the order rested with the consumer and not with us except in cases where we might receive specific instructions to shut power off from specified consumers. Compliance was so general that we received no such orders.

The effect upon our revenue was substantially in proportion to the reduced output. The amount of fuel saved was also approximately in proportion to the decrease in output. At the beginning of the five-day period we had on hand 2800 tons of coal and at its close we had on hand 1600 tons. At the beginning of the five-day period there were in transit on the steam roads, consigned to us, ninety carloads of coal. At the close of the period there were in transit on the steam roads, consigned to us, eighty carloads of coal. From these figures it is apparent that although we consumed very much less fuel the railroads and mines were unable to keep up with our requirements.

READING (PA.) TRANSIT & LIGHT COMPANY

Our 480 industries closed down on midnight of Jan. 17 to resume operation on Jan. 23, with the exception of two plants which were on the exempt list on account of working on strictly governmental work. Our newspapers and

manufacturers have shown the most enthusiastic and patriotic spirit in conforming with this plan.

MASSILLON (OHIO) ELECTRIC & GAS COMPANY

The effect has been to cut our load approximately 75 per cent and necessarily has cut our revenue by a greater percentage, but has affected our operating expenses only a very little.

CHARLESTON (S. C.) CONSOLIDATED RAILWAY & LIGHTING COMPANY

Day load reduced about one-third.

CENTRAL POWER COMPANY, NEWARK, OHIO

Our output is reduced approximately 25 per cent. Practically all of our industrial power consumers have obeyed the order to close, and we expect a reduction of 50 per cent. However, we have large power consumers in the mining districts who of course are making use of power. We anticipate a further reduction on Jan. 19 and 21, and in all probability our output will be reduced 50 per cent on account of the order. The saving is approximately 75 tons of coal per day.

MISSISSIPPI RIVER POWER COMPANY

As would be natural, the increased fuel prices during the last six months, as compared with pre-war conditions, have caused our customers to use as much of our power as they could.

The normal water power available with our present installation at this point is approximately 650,000,000 kw.-hr. per annum. Taking 5 lb. of coal per kilowatt-hour as the average consumption with the Illinois coal available in this section, we figure that this 650,000,000 kw.-hr. represents an annual fuel saving of about 1,625,000 tons of coal.

During the calendar year 1917 we manufactured 481,505,050 kw.-hr., which on the same basis of figuring as I stated above would represent a saving in coal during 1917 of about 1,200,000 tons.

ALABAMA POWER COMPANY

At present no steam energy is being supplied the hydro system of the Alabama Power Company and therefore, so far as the energy served customers by this system is concerned, they have not been affected. It possibly, however, has affected some customers who use fuel for heating or other purposes. The customers who are served by energy made by steam at points not connected with the hydro system, however, are affected by the regulation issued by the Fuel Administration governing coal consumption.

URGE FUEL ECONOMY BY SHUTTING PRIVATE PLANTS

Indiana Public Utility Men Ask Fuel Administration to Consider Cessation of Operation of Inefficient Power Stations

C. N. Wilcoxon, F. J. Haas, S. W. Greenland, Robert I. Todd and Charles L. Henry, a committee of Indiana public utility operators, have made four recommendations to Evans Woollen, Fuel Administrator, Indianapolis. The first three have to do with heating, lighting and operation of street cars. The fourth is:

One other thing we would suggest that it would be advisable to inquire into, and that is whether in many instances small power plants, which are always operated uneconomically and at a heavy expense, might be discontinued and the necessary energy now produced by them be supplied from larger and more economically operated stations. This, we consider, is a field from which much might be secured in the way of fuel economy, and it would incidentally be a benefit to the consumer of energy, because he can usually purchase energy from a larger plant at a less price than he can produce it himself at the smaller plant.

The recommendation has not yet been acted upon.

WHITE CEDAR ASSOCIATION URGES ACTION ON WAR BOARD

Problems of the Pole Industry Arising Out of the War Are Discussed at the Twenty-second Annual Meeting—J. E. Gerich Elected President

The labor situation, priority regulations, income tax laws and conditions of supply and demand in the pole market were the main topics discussed at the twenty-second annual meeting of the Northern White Cedar Association at the Hotel Radisson, Minneapolis, on Jan. 22.

The labor situation in the camps was described as one of great unrest. This condition was ascribed to the war. The belief was expressed that labor should be conscripted in order to assure a successful and vigorous prosecution of the war. The application of the income tax to individuals and to business firms was explained by several speakers. For the more vigorous prosecution of the war the following resolution was adopted:

It is hereby resolved that it is the unanimous opinion of this convention that for the best interests of the country, and to expedite the prosecution of the war to a successful conclusion at the earliest possible time, a war board should be established at once, composed of a small group of men selected from the best possible talent to be obtained in the United States, with full power to act under the direction of the President for a speedy prosecution of the war with every resource we can command.

A. T. Naugle of Chicago, speaking for the pole committee, commented upon the surprising amount of poles on hand. He ascribed this condition to some extent to the lack of transportation facilities. He stated further that the purchasing power of operating utility companies was restricted by inability to secure funds for improvements. It was the consensus of opinion that sales for the coming year would not exceed 50 per cent of those for 1917.

The report of the secretary, N. E. Boucher, stated that in 1917 traffic in cedar products had reached an extraordinary volume.

The election resulted: J. E. Gerich, MacGillis & Gibbs Company, Milwaukee, president; L. L. Hill, Page & Hill Company, Minneapolis, vice-president; W. B. Thomas, White Marble Lime Company, Manistique, Mich., treasurer; N. E. Boucher, secretary; W. L. Lafean, Nagle Pole & Tie Company, Chicago, and J. C. Kirkpatrick, National Pole Company, Escanaba, Mich., retiring president, were elected directors.

"EDISON PIONEERS" FORM ORGANIZATION

Early Associates Organize a New Society to Include Those Who Were with the Inventor Up to 1885

Early associates of Thomas A. Edison in laboratory work and his various enterprises met on the evening of Jan. 24 in the council room of the American Institute of Electrical Engineers and organized a new society to be known as the "Edison Pioneers." The following organization was effected: President, Francis R. Upton; vice-presidents, S. Z. Mitchell and T. C. Martin; secretary, R. T. Lozier; treasurer, Fred Scheffler; historian, W. H. Meadowcroft. The membership is limited to those who were with Mr. Edison up to 1885.

COAL OUTLOOK ACUTE IN THE MIDDLE WEST

Curtailment of Electric Service to Non-Essential Industries and in Some Places to Domestic Consumers Seems Inevitable

The coal situation is so serious in Illinois, Iowa, Michigan and Wisconsin that curtailment of electric service to non-essential industries, and in some places of service to domestic consumers, between 9 a. m. and 5 p. m. seems inevitable. This is the opinion of the Illinois Fuel Administration.

Speaking to a representative of the ELECTRICAL WORLD, Deputy Administrator Allen said that at present there is absolutely no reserve supply of coal.

The realization of these conditions and the desire to meet the difficulties have caused the Illinois Fuel Administrator to issue a broad order which will cover the curtailment of public utility service. This was issued purely as a coal-saving measure that is deemed necessary. The Fuel Administrator has expressed a desire to keep every public utility operating.

In some cases, among which are those of the Galesburg Railway & Light Company and the Aurora, Elgin & Chicago Railroad, coal has been confiscated to keep plants in operation.

In commenting upon this situation the Fuel Administration paid high compliments to the Insull group of public utilities. The companies had laid in large quantities of coal. When the shortage came they very liberally gave up their surplus to other public utilities and to various other concerns so that even now their own supply is short.

WAR SERVICE WORK OF THE UTILITIES COMMITTEE

National Committee on Gas and Electric Service Is Active in Many Directions Bearing on Government War Needs

A partial report of recent activities of the National Committee on Gas and Electric Service was published in the last issue of the ELECTRICAL WORLD, page 216. Other recent activities of the committee, of which J. W. Lieb is chairman, are shown in the following extracts from the report. They indicate tendencies in the affairs of the utilities and the trend of problems affecting their service in the war:

The War Department in increasing the facilities for the production of important war material is constructing and considering the construction of many new plants which will require either the installation of a complete new power plant or additions to present existing steam plants. This has brought about the necessity of requisitioning large electrical apparatus, including steam turbines, which at present are under order by the various public utilities with electrical manufacturers. In order to disturb central-station conditions as little as possible, this committee has been asked to co-operate with the War Department, and on receiving the requests of that department as to size and type of machinery required, the committee takes up with the various central stations having orders placed for delivery at about the dates these machines are required by the government. Selections are made that will disturb central-station conditions as little as possible.

Some disturbance has been caused recently to electric light and power plants when manufacturers who are being served go ahead with additional construction work and extensions to their plants without first conferring with the central-station officials as to whether the power which they apparently depended upon getting for their extensions would be available. This has happened in a number of cases, and through no fault of the public utilities they have suddenly been called upon for a supply of electrical energy which their generating capacity is unable to meet. The situation thus becomes complicated when it becomes necessary for certain industries which have enjoyed uninterrupted service to have their service curtailed or even discontinued in order to take care of the additional demands made by the enterprise of greater importance which has made the more recent demands for service.

Several delegations of steel manufacturers and others making necessary war material have visited this committee with requests that we use our influence and assistance to render possible the extensions to certain central stations upon which they expect in the near future to make heavy demands for service. This is a much better method of approach than by going ahead with their own extensions without first finding out whether power is available.

This committee is still endeavoring to obtain all the information possible regarding any excess supply of hydroelectric energy that may be available, which information is very much sought for by the government with a view to establishing munition plants and other plants to manufacture war material in the vicinity where such power would be available.

At the meeting of the war service executive committee of the United States Chamber of Commerce on Jan. 16 the National Committee on Gas and Electric Service was recognized as having been formed in accordance with the resolutions adopted at the conference of war service committee chairmen on Dec. 12 to represent the gas and electric light and power industry.

WAR SERVICE WORK OF WASHING-MACHINE MAKERS

Labor-Saving Character of Product Set Forth by the Industry, Which Is Standardizing to Effect Economies

Through its war service committee the American Washing Machine Manufacturers' Association has presented facts concerning its industry to the War Industries Board.

Every member of the association and a number of other manufacturers have agreed to eliminate 171 styles and models which might be considered as less essential as soon as present stock of material for these styles and models is consumed. They have also agreed to eliminate sixty-three parts on styles and models which they hope to be permitted to continue to manufacture, this elimination to be accomplished by standardization, use of duplicate parts now used and by elimination of parts not essential to successful marketing of the machine. They have also agreed not to purchase any more of the materials claimed as eliminated except what is absolutely necessary to balance up material now in stock.

Fuel used in the industry in 1917 included 19,641 tons of coal and 2,369,418 kw.-hr. of electrical energy. Total capital employed in the industry was $9,650,000, and the value of the product (factory) in 1917 was $10,000,000. Employees were 5000. Plants manufacturing washing machines for household use total 106.

The War Service Committee, which emphasizes the labor-saving character of the product, is composed of L. E. Dietz, H. W. Eden, J. D. A. Johnson, W. L. Rodgers and Sam T. White, chairman, and Raymond Marsh, secretary.

DISCUSSION ON WAR EFFECT AT CHICAGO SECTION, A. I. E. E.

Changing Viewpoint on Extensions for Customers Brought Out at the Western Gathering—Conservation by Commercial Departments

[This account of the discussion at the Chicago Section on the paper by Lynn S. Goodman and William B. Jackson on "Effects of War Conditions on Cost and Quality of Electric Service" follows the report of the discussion at the meetings of the New York and Boston Sections, published in the ELECTRICAL WORLD of Jan. 19, 1918, page 165.]

On account of the severe weather the attendance was small at the meeting of the Chicago Section of the American Institute of Electrical Engineers on Jan. 14. About seventy-five were present.

After Mr. Jackson had presented the paper R. F. Schuchardt, chairman of the meeting, opened the discussion. He characterized the paper as one of importance to engineers and financiers. While recognizing the pessimistic side of the paper, he spoke strongly of its brighter aspects, one of the most important of which is the widespread recognition of the real value of this economic industrial development and of the benefit from centralization which must react to the industry. He closed with an appeal to engineers to be resourceful and to create precedents rather than to follow old lines of thought.

F. A. Coffin, Milwaukee, reviewing the situation from the central-station sales department's angle, pointed out ways in which commercial engineers can effectively aid in conservation movements.

C. W. Pendell also discussed the paper from the commercial viewpoint, emphasizing the necessity that customers shall finance extensions.

D. W. Roper stated that the former value he had placed on service interruptions, nearly twenty times the loss of the revenue to the company, had undergone recently a marked revision downward on account of the changing times. He also pointed out that while formerly a customer would be taken on if his revenue would pay the cost of extensions in two years, it was now thought to be advisable to consider such customers only if the revenues would pay for the extension in two months. After outlining some curtailments of gratuitous service that had been or might be made, he emphasized the importance to central-station companies of urging a movement to diversify the hours of industrial and office employees for going to and returning from work. This would, of course, reduce the peaks of both labor and power requirements. To emphasize the importance of this Mr. Roper stated that one-third of the investment of the Commonwealth Edison Company produces only one-half of 1 per cent of the company's total output during the year.

C. A. Keller, who had made recently a study of increased values of generating stations and substations on account of present high prices, presented a table showing the percentage of increase in value to-day as compared with normal previous times. The pre-war figures were based on varying market prices over a period of ten to fifteen years before the war. The table showed that generating stations, including buildings, boiler equipment, turbines and auxiliaries and electrical equipment, have increased 45 per cent; substations, including buildings, electrical equipment and storage batteries, 30 per cent; line extensions, including conduits and tunnels, poles, cross-arms and pins, transmission lines, overhead lines, underground lines and services, 50 per cent, and transformers 30 per cent. The weighted average per cent increase over the whole list was 43 per cent.

A. Honegger, in a discussion of the difficulties of getting capital, pointed out that utility securities were being sold to farmers in some Western States.

CLEVELAND HEARING ON OHIO INDUSTRIAL LIGHTING CODE

Unusual Interest by the Manufacturers in Proper Lighting for Their Establishments Is Shown at Initial Public Hearing

Unusual interest among manufacturers in the proper lighting of their establishments was shown at the first public hearing on the proposed code of lighting for factories, mills and other workplaces for Ohio. More than 300 representatives of industrial plants and factory inspectors were on hand when the hearing opened at the Hollenden Hotel, Cleveland, on Jan. 16, under the direction of Victor T. Noonan, director of safety, Ohio Industrial Commission.

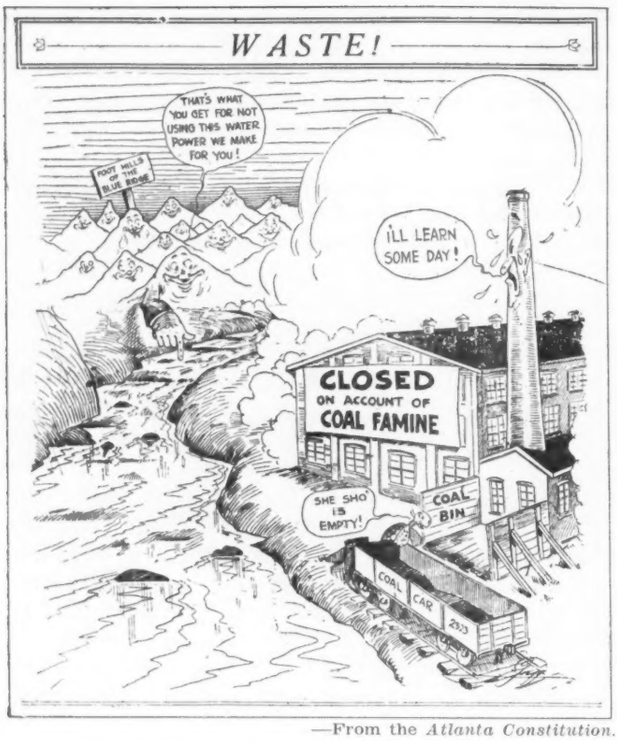
The proposed rules are based largely upon the code prepared by the Illuminating Engineering Society, but the supplementary matter differs greatly in treatment from that issued by the society. A novel feature of the Ohio code is the classification of industrial operations under the several grades of intensity required in the rules. This is the first attempt made in any state to give such definiteness to the regulations, making it possible for plant managements to know just what standards factory inspectors will require them to maintain.

It is worthy of note that no objection was voiced to the minimum values of intensity required for the several industries and operations; several plant engineers pointed out that their practice was well above these values and in some cases even above the upper values of the suggested range for good practice. Discussion of the code related largely to its construction from the legal standpoint and questions of liability under special conditions.

Educational features were combined with the hearing. The principal factors in lighting—intensity, direction, diffusion, glare, etc.—were shown by simple exhibits. There were motion pictures of industrial hazards, including insufficient and faulty illuminaton. Great interest was shown by those present in the new foot-candle meter.

The proposed code was prepared by a special committee of the Industrial Commission, consisting of Prof. F. C. Caldwell, Ohio State University, chairman; J. Q. Adams, architect, Industrial Commission; H. H. Craiglow, operating engineer Buckeye Steel Castings Company; S. E. Doane, chief engineer National Lamp Works; Thomas J. Donnelly, secretary Ohio Federation of Labor; John J. Graney, Federation of Labor, Youngstown; H. L. Jenkins, works manager, Holophane Glass Company, and George W. Walker, Cooper-Hewitt Electric Company, secretary.

Further public hearings are planned for Cincinnati and Columbus during February.


WASTE!
THAT'S WHAT YOU GET FOR NOT USING THIS WATER POWER WE MAKE FOR YOU!
FOOT HILLS OF THE BLUE RIDGE
I'LL LEARN SOME DAY!
CLOSED ON ACCOUNT OF COAL FAMINE
SHE SHO' IS EMPTY!
COAL BIN
COAL CAR

—From the *Atlanta Constitution.*

GENERAL INCREASE OF RATES MADE AT PROVIDENCE, R. I.

Features of the New Schedule Are the Coal Clause for Lighting Service and the Service Charge—No More Free Lamps

With approval of the Rhode Island Public Utilities Commission a general increase in rates by the Narragansett Electric Lighting Company, Providence, has been established, effective on all electricity billed on and after Jan. 1, 1918.

This is the first rate increase in the history of the company, covering about thirty years, although many decreases have been made. The war has brought about unforeseen and abnormal conditions, the company pointed out to the commission, resulting in changes in prices for labor and materials, especially coal, which have increased so materially the cost of producing and supplying electricity as to necessitate rate revision. The company has realized for many months that it would be necessary to change rates if public obligations are to be met and standards of service maintained, but it has deferred action as long as it reasonably could. Every effort has been made to economize, and much has been accomplished and will be continued under the new schedule, with the hope of greater savings in the future.

The chief factor in increased cost of production is coal. From Jan. 1 to Oct. 31, 1917, the company burned 75,995 tons of coal at a cost of $641,944, an average of $8.44 per ton. During the corresponding period in 1916, 49,178 tons were burned at a cost of $187,631, an average of $3.81. Making proper allowance for the increased production of electricity in 1917, the company estimates that cost of coal increased $227,000 for the ten months. This will be increased somewhat for the year.

To provide for uncertain and fluctuating coal prices, the rate schedule now adopted is based on a price of $8 per ton and is governed by a coal clause. Rates will be increased or decreased automatically according to the average price of coal at stated intervals. In this adjustment the company has endeavored to make rates equitable to all classes. In pursuance of this a service charge has been provided in connection with retail lighting. This will insure a fair return from a large number of customers whose payments under the former schedule have been insufficient to cover even the cost of installing and maintaining meter and service.

The company has also discontinued the practice of furnishing a multiplicity of meters to certain classes and the free supply of carbon lamps.

Based on 1917 sales, the new schedule would have increased the gross revenue approximately $211,000. The new schedule was submitted to representatives of Providence and to R. B. Brunet, city public service engineer, before presentation to the Public Utilities Commission. It received the approval of all these authorities.

Probably the most important revision is the introduction of a service charge of $6 per year into lighting rate "A," under which electricity is sold to residence customers and other small users. The rate was formerly 9 cents per kilowatt-hour, with no service or minimum charge. Because of this rate the company has accumulated a large number of customers using little or no electricity. In 1916 and 1917 the number of customers paying less than 50 cents per month varied from approximately 1500 to nearly 8000. This large number of unprofitable customers shifted the burden which they should have borne to those who used more electricity.

The company feels that the service charge principle is preferable to the minimum charge, as the customer who uses more electricity under a service charge gets a more favorable price. The new rate consists of a service charge of $6 per year billed at 50 cents per month and an energy charge of 7.5 cents per kilowatt-hour for all electricity used. It is provided that no electricity shall be billed at less than 9 cents net per kilowatt-hour, including both service and energy charge. Summer customers, or those requiring installation for a few months in the summer season at a location not their permanent residence, are required to pay a minimum of $10 for the season or any part. Summer customers whose residence is outside the Providence city limits are required to deposit $10 to guarantee payment.

The furnishing of lamps for first installation and renewals has been discontinued under all rates. The company has also discontinued the practice of furnishing a multiplicity of meters to customers operating office and factory buildings. The former policy was to install a lighting and power meter for each tenant in such buildings and bill the electricity to the owner or landlord. The new practice calls for the installation of one meter for each rate under which the customer purchases electricity. All other meters are furnished at a rental of 50 cents per month per meter.

The former "B" rate (for lighting customers, domestic heating appliances and motors of 1 hp. or under) has been increased ½ cent per kilowatt-hour on every step except the first, which remains at 10 cents per kilowatt-hour from 1 kw.-hr. to 499 kw.-hr. per month. The minimum rate on this schedule is 4½ cents for

5000 kw.-hr. and over, and there is a minimum charge of $2.50 per month on this rate. Time switches are rented at 50 cents per month per switch on both "A" and "B" rates. Formerly there was no minimum charge per month on the "B" rate.

The power rate "D" has also been increased ½ cent per kilowatt-hour. This is now 6½ cents net, and former minimum charges obtain of $1 per month under 2 hp., 50 cents per horsepower per month from 2 hp. to 10 hp., and $5 per month for installations exceeding 10 hp.

Power rates "F" and "G" have also been increased in both service and energy charge. The range in the "F" rate (for customers signing an annual contract with a demand of 5 hp. or more) is: 5 hp. to 10 hp. demand, monthly service charge, $1.75 per horsepower; energy charge per kilowatt-hour, 1.6 cents; for 200-hp. to 300-hp. demand, $1.25 monthly service charge per horsepower and an energy charge of 0.95 cent per kilowatt-hour. On the "G" rate (for customers signing contracts for a demand of 225 kw. or more), the range is as follows: One-year contract: 225 kw. to 300 kw., $1.54 monthly service charge per kilowatt of demand and an energy charge of 0.95 cent per kilowatt-hour; on 375 kw.-hr. and more the energy charge is 0.85 cent. On a contract for five years or more the monthly service charge for 500 kw. to 750 kw. demand is $1.44 per kilowatt of demand, and for 1500 kw. demand and more it is $1.20 per kilowatt of demand. In all cases, including these limits in demand, the energy charge is 0.85 cent per kilowatt-hour. Under the "G" rate, should the net price of energy for any month under five-year contract rates, including demand and energy charge, be lower than 1 cent per kilowatt-hour, the bill for that month is rendered either at the flat rate of 1 cent per kilowatt-hour, including demand and energy charge, or at the one-year contract rate, whichever is lower.

Financing Service Extensions

In consideration of the fact that the expense for lines and equipment necessary to supply customers is considerably in excess of normal cost and in further consideration of the difficulty of financing extensions, the customer agrees to pay to the company a sum equal to the full cost of necessary lines and equipment. Such portion as shall represent the excess cost over and above normal costs as of July 1, 1914, shall be retained by the company. The balance, "normal cost," is to be refunded to the customer annually at the rate of $20 for every $100 paid to the company for electricity used by the customer at this location. The company agrees to pay 6 per cent interest on any unrefunded balance of normal cost. After five years from the beginning of supply any unrefunded balance of normal cost becomes and remains the property of the company. The company reserves the right to refund at any time all or any part of the unrefunded portion of normal cost.

The coal clause applicable to power rates and to the lighting rate for demands over 5 kw. is based upon a cost of $8 per long ton of coal of 14,500 B.t.u. in the bunkers of the Narragansett company station. The cost of coal in the bunkers for any month is determined for such month by obtaining the true average cost of all coal in storage on the first day of such month and all coal received during such month, and after making any necessary adjustments for heating values or handling, storage and carrying charges for each month. Coal cost for any longer period is taken as the true average of monthly costs during such period. For every 10-cent decrease or increase in cost as determined below or above $8 per long ton there is a decrease or increase of 0.1 mill per kilowatt-hour under this contract. Such decrease or increase is made by periods of three months each, and the cost to be used in determining such decrease or increase for this period is that determined as above for the three months' period next preceding.

In connection with lighting rates "A" and "B," for every decrease or increase of $5 or fraction greater than one-half in the cost of coal as above determined below or above $8 per long ton there is a decrease or increase of 5 mills per kilowatt-hour sold. Any decrease or increase is made for periods of six months each, and the cost to be used in determining such change for the period is that determined as above for the six months' period next preceding.

The service charge or minimum charge under all rates other than those requiring a contract for one year or longer ceases upon discontinuance of service, but should the service be replaced within one year for the same customer $1 is charged. The customer's application forms a part of the schedule, as printed for distribution, as in the practice of the Philadelphia Electric Company.

CIVILIAN INSPECTORS ARE NEEDED FOR SIGNAL CORPS

Men of Mature Years and Judgment with Specialized Training Can Devote Services to Government in Helping Speed Production

The personnel division, inspection and training for the War Department inspection section, equipment division of the Signal Corps, in the Chicago district needs a few men of mature years and judgment to undertake work of inspection of materials, parts, sub-assembly and final assembly. Men preferably under forty years of age and over draft age are in demand.

The work is divided into five departments: Motors, instruments, fabrics, electrical work, lumber and lumber treatment. Men who have training in any of these lines and feel that they have enough education to adapt the knowledge of their profession to the government's needs by means of a short training course for inspectors in Signal Corps work may present applications.

Fred R. Jenkins, formerly manager of the Chicago Central Station Institute, is devoting a large part of his time to selection and training of men for this work. He has been appointed general supervisor of the personnel division named above, with headquarters in the Consumers' Building, Chicago. With few exceptions the Chicago district embraces all of the territory west of Pittsburgh to the Rocky Mountains and from Canada to the Gulf.

The inspectors selected must fulfill a dual function. In addition to conducting inspection work they will be expected to accelerate quantity production. The latter duty is considered of great importance. The men who are appointed as inspectors will retain their civilian status, but will be sworn employees of the government. Senior inspectors are paid not to exceed $150 per month and junior inspectors not to exceed $125 per month.

INSISTENT DEMANDS FOR MORE POWER FROM NIAGARA

Needs of War Industries and Curtailment of Supply to "Non-Essential" Industries in Buffalo District Stir Consumers to Urge Action

Aroused by the insistent demands of munition and other war industries along the American Niagara frontier for additional electric power, the government is now beginning to realize the urgent necessity of utilizing to the fullest extent the natural resources of Niagara Falls.

Unable to meet the demands for additional power, the government has been forced to requisition all of the energy produced, imported and distributed by the Niagara Falls Power Company, the Hydraulic Power Company and the Cliff Electrical Distributing Company, of Niagara Falls, and plans are now being made by the War Department for a complete redistribution. More than five score factories and mills will be cut off.

Some of these so-called non-essential industries will be supplied with limited amounts of power during off-load hours, and many will be forced to work only at night, but some have given up all hope of operation during the war.

Although the redistribution has relieved the situation considerably, the government is still unable to meet demands of war industries, and efforts will be made at this session of Congress to secure a new international treaty between the United States and Canada.

The present treaty allows diversion on the American side of 20,000 cu. ft. (560 cu. m.), and Canadian power companies have the right to divert 36,000 cu. ft. (1008 cu. m.). American power companies are not diverting all of the water allowed under the treaty because of lack of equipment. Before the war the power companies were diverting 15,600 cu. ft. (436.8 cu. m.), the maximum allowed by Congress, but until next June they have the right to divert the full 20,000 cu. ft. Instead of developing the additional 4400 cu. ft. (157 cu. m.) allowed by Congress as a temporary measure, the two American power companies are diverting only about 3000 cu. ft. (84 cu. m.) of the additional amount.

The additional diversion amounts to only 80,000 hp., which is far from sufficient for the increased demands of industries. Electrical engineers who made a recent survey on the American side say that diversion of 40,000 cu. ft. (1120 cu. m.) per second would not impair the scenic beauty of the cataract.

The Buffalo Chamber of Commerce urges the full diversion of 100,000 cu. ft. (2800 cu. m.).

Under the partial redistribution of power by the Niagara Falls Power Company and the Hydraulic Power Company two large paper mills in Niagara Falls using 5500 hp. were forced into idleness when their power supply was cut off. Plans are being made for releasing for war industries almost 7000 hp. now supplied to the Aluminum Company of America by the Hydraulic Power Company.

Phillip P. Barton, general manager Niagara Falls Power Company, says that 4000 hp. used by non-essential industries has been cut off and all other factories served by his company using 200 hp. will be cut to 100 hp. The International Railway Company will lose about 14,000 hp. now received from Niagara Falls. The International Company will be forced to rely almost exclusively upon its steam station, and the government has ordered that it pool its interests with the Buffalo General Electric Company and release 5000 hp. from its 50,000-hp. steam capacity for other industries served by the Buffalo General Electric Company. The cost of generating by coal at the International Railway steam plant is almost $40 per horsepower, and the company has been paying between $20 and $25 for Niagara Falls power.

All non-essential industries using electric power will not be allowed to operate between 8 and 10 o'clock in the morning or between 2 and 6 o'clock in the afternoon. By operating non-essential industries wholly at night there will be a saving of approximately 18,000 hp. by the Buffalo General Electric Company.

The addition to the Buffalo General Electric Company steam plant will be ready for operation early in the spring. This will mean an additional 50,000 hp. The government has negotiated with the company for an additional 50,000-hp. installation, to cost approximately $5,000,000. With the government behind the project the work can probably be completed within one year.

HEARINGS ON THE WATER-POWER BILLS

Although They Will Be Held at an Early Date, They Will Be Short, as the Country Is Well Informed on the Subject

Hearings on present water-power bills, it is expected, will take place in one or two weeks, or just as soon as the emergency war measures have been acted on by the House of Representatives.

Thus far the only measure before the committee is the Shields bill, passed by the Senate. The so-called administration measure has not yet come up for action.

It is recognized very generally that water-power legislation is needed and it will be enacted, but not as a war measure. Congressman Sims, chairman of the House committee having water-power legislation in charge, has intimated that the hearings on the measure will be short and formal, since the general subject has been pretty well thrashed out in Congress and the country is well informed.

GIFFORD PINCHOT APPROVES ADMINISTRATION BILL

In a letter issued on Nov. 16, 1917, Gifford Pinchot urged support of seven definite principles in water-power legislation. Mr. Pinchot states in a letter to the ELECTRICAL WORLD that every one of these principles is fully safeguarded in the administration's water-power bill. He adds:

> What remains, therefore, is for Congress to put this measure through without delay. The administration water-power bill will first come before the House of Representatives, where an effort will certainly be made to amend it in the interest of the power interests. If that fails, the water-power lobbyists will endeavor to have the indefensible provisions of the Shields bill substituted in the Senate for the administration bill. Beaten in that, they will fall back upon the formula of obstruction and delay they have used so successfully for the last ten years.
>
> This measure is practical, fair and wise. The friends of conservation should insist that their friends in Congress shall give their prompt and full support to the administration water-power bill, and shall see to it that it is passed without emasculation, substitution or postponement.

Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 287 of this number.

Maryland Division of the N. E. C. A.—At a recent meeting, attended by about 180 representatives of Baltimore's electrical business, the nucleus of a Maryland division of the National Electrical Contractors and Dealers' Association was organized. The principal speaker was William L. Goodwin.

Urbana (Ill.) Section, A. I. E. E.—At a joint meeting of the American Institute of Electrical Engineers, Urbana Section, and the Electrical Engineering Society, held at the University of Illinois on Jan. 18, J. L. Stair, chief engineer of the National X-Ray Reflector Company, Chicago, delivered a lecture on "Some Principles of Illumination and Their Application."

Further Development of Water Power.—In an address before the Columbus (Ohio) Rotary Club on Jan. 15, C. A. Winder, president of the Niagara Falls Rotary Club, advocated the further development of the nation's water power. The war program cannot wait, he said, and action must be prompt. The 3,000,000 or more horsepower available at Niagara Falls, said the speaker, if developed, would save for posterity about 50,000,000 tons of coal per year, or 100 tons per minute—a carload every thirty seconds.

Delegate Guests at St. Louis Jovian Luncheon.—Delegates to the first meeting of the year of the executive meeting of the National Electrical Contractors and Dealers' Association, which convened in St. Louis Jan. 22 and 23, were guests at the Jovian luncheon at the American Annex Hotel in that city Jan. 22. Col. Robley S. Stearnes, chairman of the organization, was the principal speaker of the occasion. Addresses were also made by James R. Strong, E. L. McCreary and Harry C. Brown, secretary of the organization. Fred B. Adam of the Frank Adam Electric Company officiated as chairman of the meeting.

Jovian Electric League, Los Angeles.—At the luncheon of the Jovian Electric League held Jan. 9 William F. Rice spoke on "South America." At the meeting held on Jan. 16 George A. Damon of the Bion J. Arnold Company, Chicago, and formerly dean of the Throop College of Technology, Pasadena, addressed the league on "Making Democracy Worth While." Harry W. Harrison of the Commercial Electric Garage acted as chairman of the day. At the regular Wednesday luncheon of the league on Jan. 23 Jay W. Stevens, manager of the Fire Prevention Bureau of the Pacific, gave an illustrated address on "Reducing Fire Losses." G. A. Vedder was chairman of the day.

Los Angeles Section, A. I. E. E.—H. C. Gardett, assistant engineer Los Angeles Bureau of Power and Light, gave an illustrated address at the Jan. 15 meeting of the Los Angeles Section on features of the hydroelectric development of the city of Los Angeles. A round-table talk followed on the Los Angeles aqueduct and its significance to the city in time of drought, and praise was given to the men who made its construction possible. At the February meeting J. F. Wilson, University of Southern California, will speak on "Tendencies in Design of Generators."

"Balancing the Light Beam."—Under the foregoing title, W. A. Durgin lectured before the Chicago Section of the Illuminating Engineering Society on Jan. 17. As the lecturer explained, the title was a bit of popular camouflage covering the old subject of photometry. He explained the similarity between candlepower, illumination and brightness. Some of the fundamental principles of brightness and light flux were illustrated by means of ingenious apparatus. One interesting feature was a guessing contest by the audience on equality of brightness and on the relative brightness values of several surfaces presented. This demonstrated that the eye is a very poor judge of relative brightness values except where these values are nearly equal. Even then the presence of a color difference distorted the judgment. The three most commonly used types of portable photometers were explained, the speaker going in detail into their relative good and weak points. He also made a public exhibition for the first time of a new "brightness comparator" of his design, which is intended to measure the relative brightness of two adjacent surfaces within the field of invasion, with a view to determining the contrast glare.

Central Station Versus Isolated Plant Discussed at Providence.—F. B. Kenney, Blackstone Valley Gas & Electric Company, Pawtucket, R. I., presented a paper on "The Central Station Versus the Isolated Plant" before the Providence Engineering Society Jan. 9, which was followed by a general discussion of the subject by the consulting and mill engineers present. In the discussion C. H. Bromley of *Power*, New York, said that most isolated plants fail through mismanagement, the indifference of many operating engineers to economic conditions being amazing. W. B. Lewis outlined the savings from scientific management in the plant of the Crown Hotel, Providence. The lack of interest shown by the manufacturer in his power plant was emphasized by Mr. Kenney. K. A. Skinner, Narragansett Electric Lighting Company, Providence, cited an isolated plant which ran non-condensing for about twenty-five years, changed over to condensing service, and because of some temporary noise in the piping went back to the old method. In closing, Mr. Kenney stated that the average manufacturer prefers to spend money for a tangible substance like coal rather than for an invisible service like that of the central station.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Deposits for Gas and Electric Service.—The California Railroad Commission has authorized the Santa Barbara Gas & Electric Company to modify rules as to deposits for gas or electric service in residences so as to require a rate of $2 for temporary occupancy and $1.50 for permanent occupancy for four-room flats or dwellings, $2.50 for between four and eight rooms, and $5 for eight or more rooms.

Snow in River Blocks Power House.—One of the common methods of disposing of heavy snowfalls in Chicago is to haul the snow to the river and dump it in. Following this method of procedure after the recent heavy snowfall resulted in crippling the water-power plant of the Sanitary District at Lockport. So much snow was dumped into the river that it hindered the flow and resulted in a greatly reduced output at the plant.

Drive to "Recruit" 250,000 Men for Shipbuilding.—With the aid of the Council of National Defense, the Shipping Board, governors of states, organized labor and business, the Department of Labor began on Jan. 27 the "recruiting" of an army of 250,000 men to fill all present and future needs of the shipbuilding yards of the United States. Every man in the country with some skill in a mechanical trade used in shipbuilding and willing to accept employment in this branch of war industry will be enrolled and registered in the United States Public Service Reserve, a division of the United States Employment Service and the war labor "reservoir" which the Labor Department is creating to meet the coming needs of every war industry.

Booster Station in Plant of Power Customer.—The Illinois-Pacific Glass Company, San Francisco, made application recently to the Great Western Power Company for direct-current industrial load amounting to nearly 500 kw. An examination of the direct-current distributing system developed the fact that, with copper at 40 cents per pound, it would be preferable to install an alternating-current-direct-current machine at the plant rather than to extend the service leads of the direct-current system to accommodate a load of this size at the consumer's location. The power company had on hand a direct-current motor slightly larger than the capacity required, and this machine was installed and tied in with the direct-current system serving the territory in the vicinity of the glass works. With this arrangement the machine becomes a booster of considerable value in maintaining service in that part of the town.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

C. E. Fahrney, manager of the Ottumwa Railway & Light Company, Ottumwa, Iowa, was elected director of the Ottumwa Savings Bank at its recent annual meeting.

W. E. Richards, electrical engineer of the Toledo Railways & Light Company, has been appointed a member of the electrical safety committee of the Industrial Commission of Ohio.

Harlow Moore has resigned from the position of district manager for the Pacific Power & Light Company at Seaside, Ore., to become connected with the Board of Fire Underwriters in Portland.

E. Dean Tanzer, assistant professor of electrical engineering, Lafayette College, has been appointed to the position of assistant professor of electrical engineering at the Georgia School of Technology and will assume his new duties on Feb. 1.

W. R. Davis, chief engineer of station A of the Springfield (Ill.) Gas & Electric Company, has had a grant of absence from the company while acting as chief instructor of the Naval Radio Service Training School at Dunwoody Institute, Minneapolis, Minn.

John H. Roemer, of the firm of Cummins, Roemer, Flynn, Milkewitch & McKenna, counsel to H. M. Byllesby & Company, and former chairman of the Wisconsin Railroad Commission, has been appointed one of a board of five appraisers to fix the value of the Bush Terminal properties in Brooklyn which have been taken over by the government for the period of the war. The valuation determined will be used as the basis for establishing the rental to be paid by the government.

Clayton W. Pike, consulting engineer of the Utilities Bureau, Philadelphia, has been commissioned a major in the Ordnance Department of the army. Major Pike was born in 1866 and was graduated from the Massachusetts Institute of Technology in electrical engineering in 1889. The following year he was electrical engineer for the Merrimac Manufacturing Company in charge of electric lighting, power and signals. During 1891 and 1892 he was instructor in electrical engineering in the University of Pennsylvania and during the two following years was electrical engineer for Queen & Company, manufacturers of scientific and electrical instruments. From 1895 to 1900 he was electrical engineer for the Falkenau Engineering Company, engineers and contractors, and from then till 1910 was vice-president and general manager of the Keller-Pike Company, electrical engineers and contractors. In 1912 he became chief of the Electrical Bureau of Philadelphia, resigning in 1916 to become engineer of the Utilities Bureau, which position he now holds. Mr. Pike has had a wide connection with engineering and technical societies and was president of the Electrical Section of Franklin Institute in 1896 and 1897, vice-president of the Society of Municipal Engineers in 1914 and 1915, and president of the Philadelphia Section of the A. I. E. E. in 1895.

Howard Pett, manager of the Albion plant of the Consumers' Power Company, has been appointed superintendent of power distribution of the company to succeed H. W. Courville.

S. R. Inch, operating manager of the Utah Power & Light Company, has been elected vice-president and general manager of this company, succeeding C. R. Groesbeck, who has become connected with the Electric Bond & Share Company. Mr. Inch first became connected with the Salt Lake City property Jan. 1, 1913, having previously been for seven years manager of electric light and street railway properties at Missoula, Mont.

Gerard Swope, vice-president and general sales manager of the Western Electric Company, has been decorated by the Emperor of Japan with the Order of the Rising Sun. Mr. Swope has but recently returned home after spending seven months in the Far East. Since his graduation from the Massachusetts Institute of Technology in 1895 he has been constantly in the employ of the Western Electric Company and has been general sales manager since 1908.

GERARD SWOPE

Edward J. Neary, electrical engineer with the Public Service Commission for the First District of New York, engaged on rate and capitalization cases, has been granted a leave of absence to accept an appointment as an electrical officer on board the U. S. S. Utah with a commission as lieutenant. Mr. Neary was graduated from Pennsylvania State College and has been in the electrical field for the last ten years. Since he was graduated he has been with the American Gas & Electric Company, the University of Pennsylvania, H. L. Doherty & Company and the commission.

Lester S. Ready has been made electrical engineer of the Railroad Commission of California, in charge of the gas and electric department. Mr. Ready, who has for several years been assistant engineer in this department, succeeds F. Emerson Hoar, who is now in government service.

Obituary

F. A. Driver, for many years a director of the Driver-Harris Company and identified with the company since its inception, died on Jan. 22, at the age of eighty-two years.

Henry M. Taylor, president of the American Vulcanized Fibre Company and vice-president and treasurer of the Remington Machine Company, died at his home in Wilmington, Del., on Jan. 14, at the age of fifty-nine years.

James Edward Latta, general agent of the Underwriters' Laboratories, died after a short illness at Washington, D. C., Jan. 17. He was a graduate of the University of North Carolina, the State of his birth, and of the graduate school of Harvard University. His engineering training was obtained at the Polytechnic Institute of Brooklyn, N. Y., at the Stevens Institute of Technology, and at the shops of the Westinghouse Electric & Manufacturing Company and those of the Hooven, Owens, Rentschler Company. In 1903 he was appointed assistant professor of physics in the University of North Carolina, soon becoming acting head of the department of physics and applied electricity and after a year and a half being made professor of electrical engineering. While engaged in this work until 1909 Mr. Latta frequently was called upon as a consulting and supervising engineer in various parts of the country. In 1909 he became associated with the Edison Lamp Works of the General Electric Company at Harrison, N. J., where for seven months he conducted an employees' educational course in applied electricity and illuminating engineering. Subsequently he was engaged in power-plant construction and operation in the Southwest. In the summer of 1911 he became technical editor of *Electrocraft*. When that publication was consolidated with the *Electrical Review and Western Electrician* six months later, Mr. Latta became an associate editor on the staff of this journal, having charge especially of the sections on electrical construction and inspection. In December, 1913, he was appointed special agent of the Underwriters' Laboratories, Inc., and about a year ago was advanced to the position of general agent. While making his headquarters at Chicago, Mr. Latta had traveled very extensively in all parts of the country in the last four years, representing the Laboratories at a great many conventions, meetings and conferences and helping to spread the gospel of conservation by elimination of the fire hazard. It was a trip of this kind that brought him to Washington, where on Jan. 12 he was taken down with pneumonia, to which he succumbed five days later.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Competitive Plant Construction Stopped Temporarily.—A decision has been rendered by the Colorado Public Utilities Commission on a petition of the Western Light & Power Company against the city of Loveland for a determination of the question whether the city had begun actual construction on its proposed electric light plant before July 16, 1917, and had since prosecuted such work in good faith, uninterruptedly and with reasonable diligence in proportion to the magnitude of the undertaking under any franchise, permit, ordinance, vote or other authority heretofore granted but not heretofore actually exercised, or whether a certificate of public convenience and necessity is required. The commission holds that the city began construction of its plant prior to the enactment of the amendment to the law requiring a certificate of public convenience and necessity to be obtained from the commission before a utility may enter territory now served by a utility. Therefore such a certificate is not required, but the municipality must now proceed under such rules and regulations as the commission may prescribe. The decision adds: "The testimony before the commission, with the estimates prepared by the municipality's engineer, shows that the cost of completing the proposed electric light plant has greatly increased since the beginning of the war; that this increase is such that approximately two dollars must now be spent where one would suffice under normal conditions. Recognizing the existence of this condition, and realizing also that the city of Loveland and its inhabitants are now well served by an existing public utility, the commission, under its authority to provide rules and regulations for the completion of this plant and in keeping with the intent of the law and the requests of the national government, will hold that the city of Loveland has prosecuted the work of constructing its municipal plant in good faith, uninterruptedly and with reasonable diligence according to the magnitude of the undertaking, and that the municipality may and shall proceed no further with the construction of its municipal plant until further application be made to the commission by the municipality to complete its work, or until such time as the commission on its own motion shall authorize the municipality to resume work under more normal conditions. The rights of the national government in connection with its need of materials and labor for the proper prosecution of the war must also be protected, and must be given consideration over other demands for materials and labor, except where such demands relate to matters absolutely essential to public welfare. It is the purpose of this commission, however, to provide that no public utility, taxpayer or person may again appear before the commission and attempt to show to the satisfaction of the commission that the municipality of Loveland has not proceeded in good faith, uninterruptedly and with reasonable diligence in proportion to the magnitude of the undertaking, until such time as the municipality may proceed under the regulations of the commission to construct its electric light plant in a manner to conserve to the taxpayers of Loveland their funds raised by the issuance of bonds or in the process of general taxation."

Value as Basis for Rate Increase.—A decision of the West Virginia Public Service Commission, on the application of Godfrey L. Cabot to increase natural-gas rates in Elizabeth and other communities, holds that the reasonableness of a proposed increase in rates is not established by a mere showing of increased cost of maintenance and operation, in the absence of evidence as to the value of the plant and equipment, and as to revenues and expenses.

New Securities in California.—From Jan. 1 to Dec. 22, 1917, the California Railroad Commission passed upon applications for authority to issue stock, bonds and notes involving the following amounts: Authorized, $98,168,183; denied, $2,873,283; dismissed, $1,848,706; total, $102,890,173. Of the amount authorized to be issued gas and electric companies had $52,361,557, or 53.3 per cent, divided as follows: Stock, $30,115,533; bonds, $20,070,835; notes, $2,175,189.

Cost of Making Record.—Commissioners of the Illinois Public Utility Commission have been placed in contempt of court in a friendly suit before the Circuit Court of Sangamon County, in which Springfield is situated. This will be in force until the Illinois Supreme Court decides whether a litigant taking an appeal from the commission to the Circuit Court shall pay the State for the cost of preparing the record. The question has been up for two years. The commissioners were before Judge E. S. Smith in response to a citation for contempt following their refusal to file the record in a case. The cost of preparing the record had not been paid. The commissioners were fined $25 and costs, payment being suspended during the appeal to the Supreme Court. The commission bases its demands for payment on Section 7 of the Illinois Public Utility law. In the appeal of the Springfield Gas & Electric Company from a commission order the company contested payment of the fee for preparing a record, amounting to several hundred dollars. The court required the company to deposit the amount of the fee in a bank designated by the court, pending a decision upon the point. Since then contingent payment has been guaranteed in some cases.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Modification of Commission Order.—An order of the Public Service Commission can be modified only by a formal promulgation, especially where the order itself provided that it should be modified "by further order," etc., it was held by the Appellate Division of the Supreme Court of New York (167 N. Y. S. 810).

Liability for Employees' Negligence.—Plaintiff was employed by defendant by the day to assist in or superintend the installation of certain heavy machinery in defendant's plant. Plaintiff owned and furnished and, without the direction or control of any other agent of the defendant, set up the windlass, pulleys and other apparatus, but the windlass was operated by defendant's employees. It was held by the Court of Appeals of Kentucky in Danville Light, Power & Traction Company versus Baldwin (198 S. W. 713) that if the employees operating the windlass were under the control and direction of defendant's superintendent, plaintiff was not an independent contractor, and defendant was responsible for their negligent acts causing injury to plaintiff, whether their negligence was gross or ordinary.

Municipal Rate Discrimination.—Municipalities of the State are authorized to establish, maintain and operate lighting, power and heating plants and furnish the municipality and the inhabitants thereof with light, power and heat. The powers thus conferred are proprietary in their character, and in the management and operation of such plants municipal officials are permitted wide discretion. Courts are without authority to interfere therewith upon complaint merely that the capacity of the plant is overtaxed and streets of the municipality are insufficiently lighted by reason of furnishing energy to private consumers, and that the rates charged for energy are inadequate to meet the cost of production and transmission thereof, it was held by the Supreme Court of Ohio (117 N. E. 953). But where the council of any such municipality fails to adopt and use a system or schedule of rates for energy furnished to private consumers as contemplated by the General Code, but leaves the matter of rates to the administrative officers of the municipality, who arbitrarily fix and determine the rates in each case, and in so doing unjustly discriminate between citizens in the matter of rates and service, such action constitutes an abuse of corporate power which may be restrained by the court upon suit instituted by the city solicitor or by a taxpayer if the city solicitor refuses to bring suit.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

TAKING CARE OF THE MORAL-RISK CUSTOMERS

Things That Can Be Done After Credit Is Extended on Character to Help Insure Payment of the Account

When the credit man has been prevailed upon to pass a customer's order and that customer has no collateral backing or dependable asset but his character, the time is opportune for the credit man to strengthen the customer commercially. The logical point to start would be with the customer's credit relations with his own trade.

The chances are that the facilities of this customer for securing credit information are very meager. On the other hand, the credit man has many sources of credit information at his command. This may be explained to the customer, and it may be impressed upon him that the credit man is almost a partner in his business on account of the credit extended, and also because disaster may overtake him if proper precaution is not exercised in his credit dealings. The credit man need not hesitate about virtually insisting that this customer call on him for information, especially in transactions where comparatively large amounts are involved. If the credit man will come down to his customer's level and give him proper assurance of his willingness to assist in this capacity, he will no doubt be surprised to find how careful the customer becomes and how often he consults the seller's credit man.

However, when the credit man has established such relations with the customer it will soon become evident that this customer needs suggestions in reference to the importance of properly closing orders and contracts, especially taking into account terms of sale. It is not an uncommon occurrence to find well-financed concerns taking advantage of the small man in business because he lacks backbone when soliciting the business or harbors a fear of losing the business if terms of sale are mentioned. The customer in these instances knows very well that he cannot afford to give long terms, and it is up to the credit man to bolster him up a bit and to teach him the real meaning of quick turnovers. In some cases it may even be expeditious for the credit man to make collections for the customer, so that both may receive payment without waiting for the remittance to come strolling along as the small man usually does.

MORE EVIDENCE OF BETTER TRADE MERCHANDISING

Habirshaw Electric Cable and Western Electric Put Out "Home Electrical" Manual to Facilitate Co-operation

A still further evidence of the growing tendency of the electrical industry toward a better and broader plan of merchandising is contained in "The Home Electrical" manual now being distributed by the Habirshaw Electric Cable Company and the Western Electric Company, which distributes the former's products. It is designed to "deliver complete electrical equipment to the ultimate consumer at the lowest possible cost consistent with dependable materials and skilled workmanship." The execution of this merchandising policy involves, its sponsors state, "first, the preparation and distribution of correct plans and specifications for the use of the architect; secondly, a duplicate of the architect's plans and specifications to be placed in the hands of electrical contractors; third, a practical working plan of distribution and a stabilized basis from which contractors and architects can closely estimate the investment for materials of the plans for each installation."

To this end the manual is being distributed. It contains complete plans and specifications which can be used by architects and contractors, either in whole or part, as an example to their clients of an installation for the home.

In distributing this manual the publishers state that the data contained therein were compiled from the most reliable sources and represent the best market practice. It is intended to answer all of the questions that may arise between the architect, contractor and owner in considering electrical equipment for the house.

FAN SCHEDULES FOR 1918 ANNOUNCED TO THE TRADE

Selling Policies—Price Differentials Formulated—Matter of Shortage in Question—New Standards Noticed

Fan manufacturers have announced their schedules, contracts, selling policies and other information incidental to the campaign for 1918. Heretofore a differential of about $1 each was made in the price of alternating-current and direct-current fans. This year the same practice was expected to prevail, as a difference in the manufacturing cost of the two types is claimed. On this account the schedules, it is reported, were held back longer than usual, some firms just now sending out their formal notifications. It appears that one leading producer has named the same price for both, but a majority of the remaining concerns adhere to the differential of former years.

As was pointed out in the ELECTRICAL WORLD for Oct. 13, the 1918 fan shows many new standards. The standard type will have four blades, although six blades are cataloged, in the 12-in. and 16-in. alternating-current oscillatory types. Likewise a lower figure is named for certain models on the same outlines of the more expensive kind, its reduced price being due to the absence of the speed-control switch, highly polished blades and the omission of other requirements not required for reliability and durability. Eight feet of new code reinforced cord is supplied with each fan, though six feet is specified on some less expensive types.

An increase in price of both oscillating and non-oscillating models is made in the 1918 lists, ranging from $3 to $4, $4.50 and $5 each, a little more than originally foreshadowed in the ELECTRICAL WORLD. This is owing to the increased cost of raw material and production. One house states in its printed notice to the trade, that it "cannot undertake to guarantee fan-motor prices against advance during the season of 1918 in contracts made with either wholesalers or retailers."

Discounts also vary, according to methods in vogue as between the manufacturers and buyers, the greater number adhering to the quantity basis plan. A prominent producer who has followed this rule in his other lines is putting it to work on fans this year for the first time. Discount arrangements are subject to various considerations and differ with each of the manufacturing companies.

The fan-selling season proper is usually during the first quarter of the year. Delivery of requirements are to be made before the expiration of the contract date. The buying so far on the part of jobbers and dealers is understood to exceed that of last year. Much speculation has been indulged in as to a shortage of fans. Authorities agree and disagree on this point, but one of the largest distributing companies has already announced, and in a public manner, that "there is sure to be a shortage of fans next summer."

BUSINESS IN MOTORS REMARKABLY SOUND

Large Buying Expected to Develop for Small Units for Industrial Drive to Displace Many Large Units Now on Group Drive

The well-sustained volume of business in electric motors under all vicissitudes of trade speaks well for the future of this branch of electrical manufacturing and distribution. While *less essential* industries—there are few really "non-essentials"—show declines in purchasing, the acceleration of military and naval preparations throughout the country is absorbing practically all the motors which can be built, and deliveries on the largest sizes are fast approaching a year, including both freight and express delays. The first rush of munitions plant requirements led to a heavy volume of large unit buying in the motor trade, group drive being necessarily first installed on account of its lower first cost, the latitude available in reserve capacity in many installations, minor importance of electrical efficiency at the start of war operations, and general overload characteristics. At present the volume of this large-motor business is still very great, but the increasing importance of fuel conservation through the use of more efficient power equipment is leading to a more general consideration of industrial motor-drive betterment problems. This means that more and more smaller motor units will be required to handle existing and developing loads, and well-informed opinion is that after the war and perhaps earlier the large-motor market will be overstocked through the release of many units now operated upon an inefficient basis and the substitution of small units for individual or subdivided group driving.

The fuel shortage has focused attention upon the value of hydroelectric energy, and the outlook for profitable motor business and economic applications is nothing less than remarkable, taking the long view ahead. Power users recognize the necessity of maintaining motor prices at levels yielding a fair profit to the manufacturer and distributer, and the indications are that no branch of the electrical manufacturing industry faces brighter prospects to-day.

METAL MARKET SITUATION

A Stronger Sale of Copper Is Looked For—Wire Products Easier—No Tin in Sight

Wire prices, while being figured on a 30-cent base, are reported easier, with a tendency to softness. Large consumers are buying practically at their own price but with reservations. The extension of the official price of copper for four months ahead has had a stabilizing effect, and purchases of the metal may be on a more liberal scale. Transportation, labor and other difficulties are having their effect on industrial consumers of copper, more so than on the producers. The consumer is dependent on a doubtful and unsettled domestic demand, which is unsettling. If under current conditions the output shall exceed consumption, it will have an effect on the price that will rule after the present term expires. Other metals remain about the same, excepting tin, which is scarce, with no relief in sight.

NEW YORK METAL MARKET PRICES

	Jan. 21	Jan. 28
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	27.00	27.00
Lead, trust price	6.75	6.75
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	7.82½ to 7.92½	7.82½ to 7.92½
Tin, Straits	85.00*	85.00*
Aluminum, 98 to 99 per cent	34.00 to 36.00	34.00 to 36.00

OLD METALS

Heavy copper and wire	21.50 to 22.00	21.50 to 22.00
Brass, heavy	13.75 to 14.50	13.75 to 14.50
Brass, light	10.00 to 10.50	10.00 to 10.50
Lead, heavy	6.25 to 6.37½	6.20 to 6.25
Zinc, old scrap	5.00 to 5.50	5.00 to 5.50

*Nominal.

THE WEEK IN TRADE

STORMS and embargoes have held up freights in all parts of the country, excepting in the South, during the week so that deliveries were not greatly improved, if at all. In some instances the delay is reducing electrical stock to a point where jobbers and dealers are disturbed over the outlook. With this temporary check, however, sales and trade in general are reported as increasing. Where business was practically suspended on account of the blizzards, the normal status is resumed. The labor shortage is becoming more acute where large industrial enterprises of a government nature are centered. A shortage of new motors is said to exist in some sections, but used machines are selling better elsewhere owing to shorter deliveries. Fixtures, washers and heavy equipment are recorded in the improved sales class.

Collections range from fair to excellent, January being said to be better than December. Industrial accounts are particularly prompt in settlement. Credits continue to be carefully looked after.

NEW YORK

Concern over the slow delivery of goods is expressed by representative jobbers and distributing houses. It is said that manufacturers who are unable to carry out their time contracts are offering various excuses for the non-delivery of electrical merchandise, the greater number of which are not only valid but are governed by circumstances which they are powerless to remedy. The buying of staples continues along conservative lines. Heating appliances are coming into the market in larger lots, but a scarcity still exists. Wiring material is slightly easier in price. Collections have been impaired by the severe weather, but credits are still treated with a great deal of circumspection.

A jobber, with a wide reputation as a heavy operator in every line of electrical staples, specialties and general merchandise, is revising his entire price list. Notable changes are not exactly the purpose of the revision, but there may be surprises in store. The new list is down for appearance along in February, and in certain instances the figures are to harmonize and tie up with the Goodwin plan of buying and selling, which is interesting the trade.

SMALL MOTORS.—While deliveries for standard sizes are better, prices have also receded slightly, but not so much as to affect conditions a great deal.

LAMPS.—Manufacturers are gradually catching up on past shortages on standard sizes, but some types are still short. With the anticipated demand for large quantities of all kinds of lamps that the government will doubtless requisition in the near future, to meet the requirements of the vast housing preparations of the Shipping Board, now under way, it is possible that the situation may be again seriously affected.

ELECTRIC RADIATORS.—Marked efforts are being made to push through a number of important shipments of electric radiators to meet the extraordinary demands in New York City and neighboring places.

COLLECTIONS AND CREDITS.—As mentioned in a previous review, the holding up of freight—the exasperation connected with the slow arrival of merchandise—has had a shrinking effect on collections, which have heretofore been quite satisfactory. The credit managers are exercising their usual care in disposing of applications for time accommodation in opening accounts.

LIGHTING FIXTURES.—Trade is still rather quiet, owing to the practical elimination of building operations. A well-known firm just issuing its new price list is making a few slight increases on fixtures having heavy brass castings,

but on the regular line a shade lower is noted—an "even break," as the house expressed it. Bowls, shades, etc., are spoken of as being in ample supply, with shipments from the factories coming out of stock. Deliveries are three and four months back.

FLASHLAMPS.—Trade in flashlamps is very active, the recent advance apparently not affecting the sale appreciably. It is a question just now of obtaining stock.

CROSS-ARMS.—With the rapid absorption of the visible stock of cross-arms for cantonment and general government purposes, the supply is growing less. Prices, as stated last week, took a jump, and if a further increase should come along large handlers would not be surprised.

HOUSEHOLD SPECIALTIES.—Excepting heating appliances, the sale of household energy-consuming specialties has been affected to some extent by the conservation of energy by the central stations. Goods of this description are expected to move more rapidly when the fuel-saving situation is not so acute.

CHICAGO

The trade has recovered from the blizzards and is back on a normal basis. During the stormy days when shipments were not made on account of lack of transportation facilities orders piled up to an appreciable extent. These have all been filled and shipped now. Heatless Monday was a boon to some jobbers. The railroads were not receiving freight, but were giving all assistance in getting incoming shipments unloaded. This permitted jobbers to put their entire merchandise handling departments to work on the incoming shipments with the result that goods were received, checked and shelved in one day, whereas, in the ordinary run of things, the handling of the same volume would have taken a week. The lull in business that usually follows the inventory period is reported to be about over and normal movement being slowly resumed.

COPPER.—To some observers the future price of wire to the trade is a puzzle. The government has of course fixed the price of ingots at 23.5 cents. Ordinarily the mills formerly got about 1 cent a pound for working it up. Now they get, on account of labor conditions, from 3 cents to 4 cents, bringing factory prices on wire up to 26.5 cents to 27.5 cents. The Chicago jobbers are at present continuing on a 30-cent base for rubber-covered and a 28-cent base on weatherproof.

MOTORS.—Sizes smaller than 15 hp. can be had on immediate delivery. The large sizes are more scarce.

SECOND-HAND MACHINERY.—Bad weather has interfered with inquiries in the last few weeks. This slowing up is regarded as temporary. Prices show no signs of breaking. In fact, some buyers are paying more for second-hand motors than they would have to pay for new motors out of stock owing to the panicky condition of the market. The outlook for 1918 is considered good, the usual run of factory changes being looked to to produce much of the business. Analyses of 1917 business show that the volume of business in dollars was greater than that of 1916, but that the tonnage was just a trifle under that of 1916.

MERCURY-VAPOR LAMPS.—The large amount of industrial night work that is going on is making a real market for mercury-vapor lamps. One company's 1917 business in the Chicago district increased 43 per cent over that of 1916. Deliveries on direct-current lamps are on about a ten-day basis. Deliveries on alternating-current lamps are on about a three-week basis.

LAMP GUARDS.—Industrial activities and the higher price of lamps are making a lively market for lamp guards. Government orders in the hands of some manufacturers have set back deliveries from out of stock to ten days.

CEDAR POLES.—Lack of transportation facilities and slowing up of utilities' activity have acted to create large stocks of poles in the hands of distributers. The 1918 pole buying is expected to be about 50 per cent of that for 1917.

FUSE SWITCHES.—A few large orders have been received, and these tend to make the market continue to appear active.

BOSTON

Jobbers report a reasonably good volume of business, with but a slight falling off due to the enforced holidays and weekly shutdown. Stocks are substantial, although railroad embargoes and congestion are hampering deliveries sufficiently to retard considerably the replacement of shipped materials. No let-up appears in government orders, and important consignments are being billed for foreign use as well as for service in military and naval establishments on this continent. House wiring is very quiet over New England as a whole. Central stations are recovering somewhat from the effects of the "heatless Monday" order, as additional exemptions are provided.

Prices hold firm in most lines, but an advance in washing machines is rumored to be in prospect. Central stations report good results from vacuum cleaner campaigns now under way, the Feb. 1 price advance being a decided stimulus to earlier installment buying. Labor is getting scarcer and the more general use of women in industry cannot long be deferred. One prominent jobber reports a 20 per cent larger trade in December than a year ago, with large mill business, running as high as $30,000 per annum in an individual case. Collections are fair, and from industrial customers excellent.

The Massachusetts Gas and Electric Light Commission also has just made public a statement emphasizing the fundamental soundness of the central-station industry and the expectation that dividends will continue along present lines despite the adverse effects of the war.

MOTORS.—A prominent dealer states that 90 per cent of the motor business of New England is associated with the war industry, and that the volume of sales shows no sign of falling off. On motors of 75-hp. rating and over nine months' delivery is being quoted. Prices are firm, and the above dealer is of the opinion that there are not over 500 motors in New England stocks ready for instant shipment. Illustrating the present scarcity, $200 was lately paid for a dozen frames of motors of 1-hp. to 5-hp. rating, with windings totally ruined by overheating, and in other cases higher prices are being paid for second-hand than for first-hand units, because of better delivery conditions.

WIRE AND CABLE.—Stocks are increasing, at least temporarily. One large manufacturer reports putting the first stock order through the works for many months, covering varied sizes. Weatherproof wire is quoted at 27 cents and rubber-covered at 30 cents.

ELECTRIC PASSENGER CARS.—The scarcity of chauffeurs and good performance of electric vehicles in Boston during the cold weather promise a healthy spring business. Consistent work among suburban "prospects" is yielding results; power requirements are relatively small, and where intelligent sales methods are applied growth of business seems certain to follow.

VACUUM CLEANERS.—The drive to sell these machines in larger numbers prior to the advance of Feb. 1 gave every evidence of success early in the week. Cleaners are becoming almost as much of a staple as electric irons, and few are returned after being placed on trial.

FLASHLAMPS.—Business shows a slight falling off of late. If the second draft comes early in the spring, a boom in these devices is expected to follow.

CONDUIT.—Smaller sizes of pipe are accumulating in the stockrooms, but deliveries are in general irregular and much of the local buying in New England is on the hit-or-miss order.

ATLANTA

No visible effects of the embargo on some of the Eastern railroads have been noticed in the Southeast this week. As a matter of fact, this section is too busy with other problems since last week's industrial dislocation by the fuel order. The various hydroelectric power companies rendered invaluable service during the period of shutdown and are rewarded by the fact that a number of essential industries were kept running. A sleet storm visited this section early in the week and caused considerable damage, tying up street-car service and crippling lighting and power systems.

All telephone, telegraph and power lines are reported as repaired, and practically normal conditions prevail. There is a movement to restrict unnecessary building and other enterprises not essential to the war and to save capital investments for war bonds, the idea being to appoint local committees of business men and bankers and intrust them with the task of cutting off at the source proposed expenditures which can be eliminated during the war. It is not expected that this movement will make much headway for a time. Anyway, a large volume of construction has already been projected and the momentum of this business will continue for some time.

Manufacturers and jobbers state that collections are excellent and that January is showing up much better than December. A number of municipalities which are unfortunately not situated near hydroelectric systems are being hard pressed for ready funds, owing to the fuel situation. These seem to be the only cases materially affecting the credit outlook at present.

LIGHTNING ARRESTERS.—Heretofore the demand for this line was more or less sporadic, but expansion of transmission systems in the Southeast has tended to flatten out the demand. Manufacturers report that last week's thunderstorm stimulated sales and brought to the attention of operating engineers the necessity of anticipating summer requirements. The aluminum-cell type has been quite active, but deliveries are slowing up. Manufacturers report great difficulty in securing steel containers and aluminum. Arresters for 6600 volts and below are promised for two months. Higher potentials cannot be had in less than five months, with the possibility of even longer shipments. There has been no decided change in prices recently.

ELECTRIC HEATERS.—The call for heaters of all types has been good this winter and a large volume of sales has been recorded, but when the recent five-day fuel order made itself felt the demand for heaters was more than local and scattered stocks could stand. From information at hand it appears that all the heater stocks are exhausted, and as there will be eight more heatless Mondays the prospects are very bright for more big business in this line.

SEATTLE

There were no outstanding features in the past week's business. Jobbers say that the volume of sales to shipyards, lumber mills and industrial plants was noticeably less than during the last three weeks. Sales to the government were also negligible, with the exception of orders for lamps and wiring devices for additional cantonment work. Retailers report a noticeable increase in volume due to the incipient building boom in Puget Sound cities. This volume is expected to increase. Several inquiries from a big shipbuilding concern and allied industries for heavy equipment indicate that February's total, provided orders are placed, will be heavy. Few new credits were placed during the past two weeks. Collections are satisfactory.

Seattle apparently is experiencing a building boom as regards the erection of residences. Opinions differ as to whether the present rate of construction will continue. In spite of the fact that January is regarded as a particularly unfavorable month for building activity, 130 new residences were started during the first twenty-eight days.

The establishment of many camps and portable sawmills and construction of new railroad lines in the Grays Harbor country will follow the recent award of the government of the contract for millions of feet of airplane spruce on the "cost plus" basis. The contract for furnishing more than $100,000 worth of machinery, including a large amount of electrical equipment, was awarded last week by a new Grays Harbor shipbuilding concern.

The freight situation in the Northwest remains the same as reported for the past month. There has been no speeding up, and over 5000 carloads of Oriental freight in Seattle yards and hundreds of carloads in warehouses block the efforts of railroads to solve the traffic problem. To relieve this congestion and prevent a railroad embargo, steamship and railroad officials representing all the principal lines have agreed to a steamship pooling arrangement designed to facilitate the quick handling of freight and to be used only in case of necessity. The embargo on the shipment of freight other than fuel, food or munitions now in effect on Eastern lines has not been emphasized to date, although it is expected to materialize.

Appliances as a whole are moving satisfactorily. Jobbers state that the sale of sewing machines during the month of January has never been equaled in the Northwest. Immediately following the holiday let-down this appliance began to move and this movement is increasing daily. Dealers state that the Christmas sales of machines have proved the best advertisement possible. Stocks of appliances are fluctuating considerably, but at present are in fair shape. Floodlamp sales have been on a decided increase the past two weeks and a slight shortage is noted. Portables are moving satisfactorily and shortages on other lamps are very pronounced. The volume of sales is well sustained. Motor and transformer sales slowed up slightly during the past week. No orders of important consequence were placed.

SAN FRANCISCO

The long-continued drought in California is causing much concern in all lines of business and there is apprehension that the coming year will see hard times because general prosperity in California is so closely related to good crops. For the time being, however, the drought is bringing a rush of motor and transformer business from farmers who desire to install pumping systems to insure water supply. During freight clearance week more than 3500 freight cars were released in California. The saving of 20,000 kw. which was available immediately after the consolidation of the four large power companies has provided power for immediate needs, and this load is rapidly being absorbed chiefly in comparatively small blocks.

Shipyard activity is steadily increasing, and as the first boats are launched new keels are laid so that there is a steady demand for electrical supplies in that line. Renewed activity in building construction is in prospect in San Francisco. The building inspector's office announces considerable more business in the month of January than was done in the preceding three months combined. New contracts are for industrial loft, light manufacturing and automobile uses. No hotel, office or apartment buildings are included.

CREDITS AND COLLECTIONS.—These continue in good shape. The readjustment to business on a war basis seems to have been completed even in the retail shops, and concentrating on lines that can be moved now has improved business conditions. Credits are still scrutinized closely and overstocking on a high-price basis is being carefully avoided.

LAMPS.—The situation remains in a strained condition, and dealers are inclined to complain about the difficulty of securing supplies, but in reality actual needs are adequately handled as heretofore.

WIRE.—Rubber-covered wire stocks have been seriously depleted of late by the slowing down of deliveries without corresponding decrease in demand. Despite this condition a tendency to a lower price is reported. Weatherproof wire stocks are also in worse shape than before, but are not so bad as rubber-covered.

CONDUIT.—Stocks are in worse shape because of poor deliveries. However, demand in this line is below normal, the chief fields now being the government and industrial.

GLASS INSULATORS.—In this line considerable uncertainty has arisen because of the manufacturers' announcement that orders will be accepted only at prices as of date of shipment. The fact that shipments are poor adds to the uncertainty.

POLE-LINE HARDWARE.—Since the first of the year construction has dropped off. Good stocks are in hand.

MOTORS.—The demand for agricultural purposes is increasing. The question of delivery is now entirely a matter of a priority order. The Priority Board is very careful and only unquestionable claims are allowed. Stocks are continually improving. One manufacturer, for example, who recently quoted stock delivery on single-phase motors up to 15 hp., later moved this up to 20 hp. and now quotes up to 30 hp. from stock.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to $61.00
Coil to 1000 ft	+10% to 59.17
	No. 12 Solid
Less than coil	List to $71.00
Coil to 1000 ft	—10% to 68.87

Twin-Conductor

	No. 14 Solid
Less than coil	List to $105.00
Coil to 1000 ft	$70.00 to 10%
	No. 12 Solid
Less than coil	10% to $135
Coil to 1000 ft	10% to $130.95

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+10% to +20%
Coil to 1000 ft	— 5% to —10%
	No. 12 Solid
Less than coil	+10% to +20%
Coil to 1000 ft	— 5% to —10%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to $115
Coil to 1000 ft	—10% to $80
	No. 12 Solid
Less than coil	+10% to +20%
Coil to 1000 ft	— 5% to —10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg.	34%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to 12%
1/5 to std. pkg	20% to list
Std. pkg.	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175	.3275
Barrel lots	.2875	.2975

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, Per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp.	Net to $75.00	—15% to $69.75
3/8-in. d. stp.	List to 75.60	—15% to 72.00
1/2-in. s. stp.	List to 100.00	—15% to 93.00
1/2-in. d. stp.	List to 100.00	List to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.25	71.25
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List Per Foot	Size, In.	List Per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in. $25.00-$55.00	$20.50-$24.50	$20.00-$21.50
1/4-in.— $28.00-$60.00	$22.50-$27.00	$20.00-$23.50

NET PER 1000 FT.—CHICAGO

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in. $36.00-$55.00	$25.00-$37.50	$22.50-$24.75
1/4-in.— $40.00-$60.00	$27.00-$30.00	$25.00-$27.00

CONDUIT, COUPLINGS AND ELBOWS. RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot	Couplings, List	Elbows, List
1/4	$0.08 1/2	$0.05	$0.19
3/8	.08 1/2	.06	.19
1/2	.08 1/2	.07	.19
3/4	.11 1/2	.10	.25
1	.17	.13	.37
1 1/4	.23	.17	.45
1 1/2	.27 1/2	.21	.50
2	.37	.28	1.10
2 1/2	.58 1/2	.40	1.80
3	.76 1/2	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 6%	7% to 9%
2500 to 5000 lb.	6% to 8%	9% to 11%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	1.3% to 4.7%	4.2% to 7.7%
2500-5000 lb.	3.3% to 6.7%	6.3% to 9.9%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$5.00 to $6.00
Discount	30%

CHICAGO

List	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	38%
1/5 to std. pkg.	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	38%
1/5 to std. pkg.	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00 to $5.75
1/5 to std. pkg.	4.50

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$24.90 to $31.00
Coil to 1000 ft.	22.72 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.00 to $35.60
Coil to 1000 ft.	21.50 to 26.70

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$20.00 to $29.00

CHICAGO

Net per 100	$19.25 to $25.75

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%-37%	20%-32%
$10.00 to $50.00 list	42%-45%	37%-40%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15% to 20%

NET PER 100—CHICAGO

Less than 1/5 std. pkg.	$25.00 to $45.00
1/5 std. pkg.	23.00 to 42.00

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	—10%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	—5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	List
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to —15%
Std. pkg.	List to 30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	Net
$2.00 to $10.00 list	10% to 20%	5%
$10.00 to $50.00 list	20% to 30%	15%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00
Discount	—

CHICAGO

List price	$4.50 to $6.00
Discount	25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.44¼
No. 18, full spools	0.43¼

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.57½ to $0.65
No. 18, full spools	0.50 to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
11	$15.00-$18.00	$13.00	$11.25-$11.50
12	23.25- 25.41	21.30- 21.78	15.97- 19.35
10	32.40- 35.21	29.70- 30.18	22.13- 27.00
8	45.70- 49.12	41.90- 42.12	30.88- 38.00
6	72.40- 77.84	66.35- 66.72	48.93- 60.30

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00	$13.00-$13.50	$11.50-$12.00
12	25.33- 26.28	22.02- 25.33	18.35- 20.93
10	30.48- 36.54	27.94- 31.26	22.86- 29.23
8	42.54- 51.57	38.99- 44.13	31.90- 41.36
6	66.46- 88.38	56.15- 75.61	50.53- 70.70

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $35.25
25 to 50 lb.	31.25 .....
50 to 100 lb.	34.25 to 38.25

CHICAGO

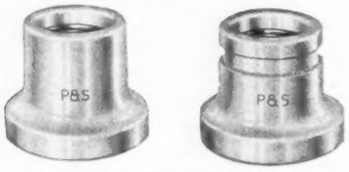
	Per 100 Lb. Net
Less than 25 lb.	$35.50 to $40.35
25 to 50 lb.	34.35 to 39.35
50 to 100 lb.	33.50 to 38.35

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Porcelain Concealed Receptacles

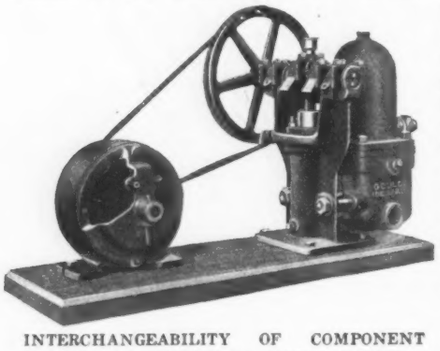
Pass & Seymour of Solvay, N. Y., have brought out two porcelain concealed receptacles, to be known as P. & S. 4000 and 4001. The wires are introduced from the back of these receptacles. The outer porcelain shell entirely conceals the supporting screws as well as the binding screws and terminals. P. & S. 4000 is shown without the shade-holder groove and P. & S. 4001 with the shade-holder groove. The outside diameter of the base of these receptacles is 2 5/16 in. (5.87 cm.).



RECEPTACLES WITHOUT AND WITH SHADE-HOLDER GROOVE

Pumps and Pumping Outfits

The Goulds Manufacturing Company of Seneca Falls, N. Y., is placing on the market a new line of "Hi-Speed" pumps and pumping outfits that are supplied in 3-gal. and 6-gal. (11.4-l. and 22.7-l.) sizes. This line consists of thirteen outfits, twelve of which are motor-driven. It is pointed out that the small capacity is ideal from the central-station standpoint in that it carries the pumping over a longer period of time, thereby doing away with the objection of having pumps of larger capacity operating for only a few minutes during the day. Attention is called to the interchangeability of the component parts. This interchangeability of component parts, it is said, will enable the dealer, by having one complete outfit in stock and various extra parts, to make up any one of the thirteen different outfits. Four of these outfits are supplied with 32-volt motors, making the outfits suitable for operating from farm lighting sets.



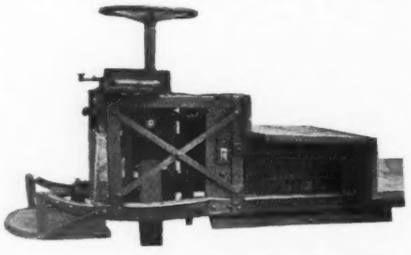
INTERCHANGEABILITY OF COMPONENT PARTS A FEATURE OF THESE PUMPS

It is pointed out that all gears have been eliminated, thereby making the pump absolutely quiet and smooth-running. The pump operates on a speed of 500 r.p.m. This allows it to be belt-driven from either electric motors or gasoline engines with only a slight reduction and consequently with a small pump pulley instead of the extra-large pulley usually required.

Industrial Floor Trucks and Tractors

The special features pointed out for the electric industrial floor truck shown herewith, made by the Enterprise Machine Works of Los Angeles, Cal., is turning in wheel-base length, simple in its make-up, low first cost, low upkeep, speed control system without resistance, 25 per cent reduction in weight. This truck is said to be the first floor truck to be placed on the market that demands from the storage battery a current supply below the normal rate of discharge.

The truck is equipped with a special high-speed four-pole motor, running on Hess-Bright ball bearings, mounted on the yoke over the traction wheel and geared thereto for propulsion and steering of the truck. The Haschke non-resistance speed-control system is used. The battery is always in series, and the three speeds are obtained by cutting out (harmoniously on each pole piece) field coils. It is equipped with a speed controller, consisting of a single switch blade conveyed into three switch jaws, and is the only continuous torque control system on the market. The control of the motor can also be operated by the foot brake automatically. As standard equipment a fourteen-cell, fifteen-plate battery is used, either Gould, Exide or Philadelphia make.



NON-RESISTANCE SPEED-CONTROL SYSTEM USED

Steering is accomplished by mounting direct to the steering head a large-size automobile steering wheel. The steering head revolves in a Timken roller bearing and has two projecting arms terminating with small ball-bearing wheels running on a circular track, to withstand rough roadbed operating.

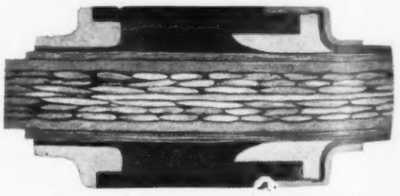
Light Controller

The automatic light controller here described is placed on the dash under the hood of an automobile and requires no adjustment or manipulation by the operator of the car. By means of a moving armature, which is automatically pulled under a magnetized field as the car speeds up and drops out as the speed decreases, the lights are kept practically constant throughout the range of speed of the car. It is manufactured for use on Ford cars in which an alternating-current magneto is used. The controller operates on the impedance or reactance principle. The American Sales Corporation is the sole distributer in the United States, with headquarters at 614 Fulton Building, Pittsburgh.

Cable Potheads

The Philadelphia Electric Company Supply Department of Philadelphia has placed on the market a cable pothead in which the base member consists of two parts so arranged that when they are screwed together they serve to clamp the lead sheath, forming an effective waterproof and solderless joint. The inner members form a static shield of the pothead and are so constructed as to provide a gradually diverging concentric continuation of the inner surface of the metal sheath. By means of this form of construction the belling effect can be reduced to a minimum, resulting in a compact design. When completely assembled the entire surface is surrounded by a compound which eliminates all air from this surface and distributes with absolute uniformity any static strains which arise, it is claimed.

The body of the pothead is constructed of fiber, porcelain or metal, dependent upon the class of service required. The cover is furnished with either disconnecting or non-disconnecting terminal bushings and is made in composition, porcelain or metal.



DETAILS OF PRINCIPAL ELEMENTS

Electric Motor Clamshell Bucket

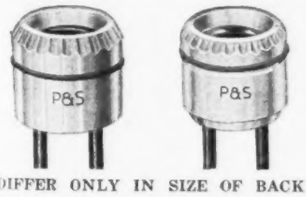
The Hayward Company, 50 Church Street, New York City, is manufacturing the electric motor bucket shown herewith. This bucket, as the name indicates, has as an integral part a

EQUIPPED WITH MOTOR-OPERATED WINDING MECHANISM

motor-operated winding mechanism which opens and closes the jaws of the bucket, making it an electrically operated unit. Attention is called to the fact that an important feature of this bucket is the introduction into the transmission of a multiple-disk clutch, its function being to slip and permit the motor to continue to run in case the edges of the bucket come together or are held apart by some obstruction, while the controller is in the closing position. This eliminates the necessity of limit switches, circuit breakers or similar devices, and makes the bucket practically "foolproof" in the hands of the ordinary crane operator.

Receptacles

P. & S. 4003, which is a companion piece to P. & S. 437, is a short-backed receptacle furnished with 6-in. (15.2-cm.) leading-in wires and has been de-



DIFFER ONLY IN SIZE OF BACK

veloped by Pass & Seymour, Solvay, N. Y. P. & S. 4035 is a screw-ring sign and outlet-box receptacle of the same series as P. & S. 437 and P. & S. 4003 and differs from P. & S. 4003 only in that it has a 1-in. (2.54-cm.) back.

Color-Matching Unit

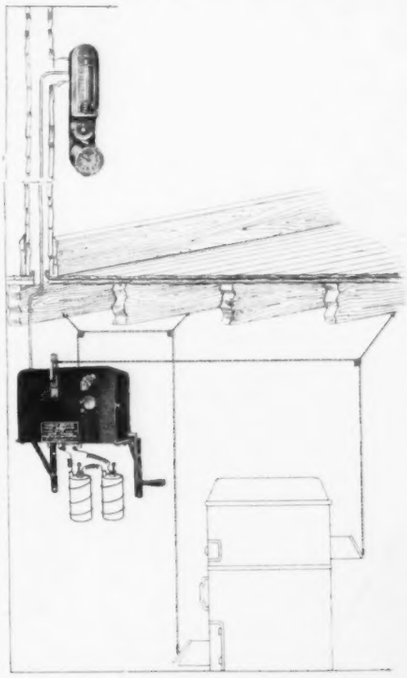
The Nela Specialties Division, Nela Park, Cleveland, Ohio, has developed and is marketing the new "Trutint" units, one a portable color-matching unit, the other a pendent unit. The pendent unit is a substantial fixture of pleasing design, made of spun brass, regularly furnished with a cloister finish. Other finishes may be obtained on special order. This unit is suitable for hanging over a showcase or counter.

The portable unit fills a demand for a color-matching unit suitable for use in high-class shops and stores. It is neat, of pleasing appearance, compact, substantial and adaptable to almost any service that may be desired of a color-matching unit. The reflector is of spun brass, the arm of steel, both heavily nickeled. The base is of iron, finished in black. The unit is recommended for use on counters or showcases of shops of the highest class.

Heat Regulator

The Western Electric Company of New York is offering to the trade a heat regulator which, it is said, prevents the overheating of the furnace and thus the wasting of fuel. It permits the maintaining of comparatively low temperature at night and at a predetermined hour in the morning will automatically open the drafts.

A thermostat is mounted on the wall on the first floor. Connected to this is a cable running to a motor in the basement. A change of the room tempera-



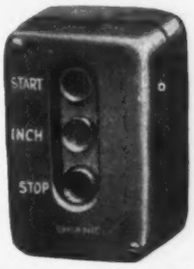
BATTERY-OPERATED HEAT REGULATOR

ture on the first floor of 1 deg. causes an electrical impulse to be sent to the motor box, and the drafts will be opened or closed as required. This device will regulate the underfeed draft and the check damper of either hot-air, steam or hot-water furnaces. It can also be applied so as to govern the main valve on gas, municipal or community steam-heating plants.

Two types are made, one for homes that are not wired for electricity where two cells of dry batteries on a substantial spring motor are furnished. The other type is used in homes wired for electricity. This is equipped with an alternating-current motor and a transformer to furnish low voltage for use on the thermostat circuit.

Master Switch

The master switch shown herewith has an "inching" button as well as a starting and stopping button. When the "inching" button is pressed the motor circuit is closed, but the starting resistance is not short-circuited, conse-



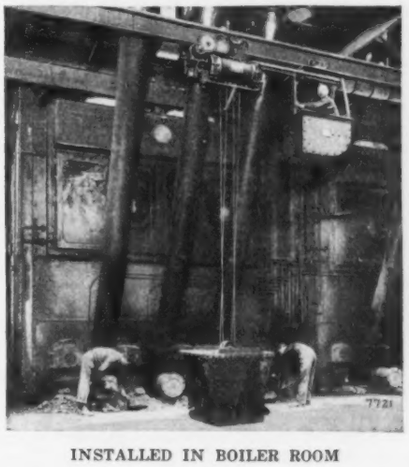
EQUIPPED WITH AN "INCHING" BUTTON

quently the motor starts, but only runs at a low speed and stops immediately pressure of the "inching" button ceases. This switch is a product of the Igranic Electric Company, Ltd., of London, Eng.

Electric Monorail Hoists for Handling Ashes

A monorail electric hoist with a bottom dumping bucket for handling ashes is made by the Link-Belt Company of Chicago. This machine runs on the lower flange of an I-beam track. It is operated by a man traveling in a trailer cage who controls the raising or lowering of the bucket as well as the travel of the hoist. The laborers who clean the fires fill the bucket with ashes; the operator then hoists the bucket and runs it out directly over the car, where it is dumped by the motion of a lever in the cage.

The machine is very compact and requires little headroom—an important consideration in an installation where it is necessary to get a large bucket over the side of a high-side gondola car.



INSTALLED IN BOILER ROOM

In many instances, an overhead bin cannot be installed for lack of space. It may then be practicable to use the same monorail hoist system to handle the coal as well as the ashes. Better even than this, a bucket with a small chute and under-cut gate is often used.

Trade Notes

THE ARNOLD COMPANY, constructing engineer, 105 South La Salle Street, Chicago, has discontinued its New York office at 111 Broadway.

THE CRESCENT ELECTRIC MANUFACTURING COMPANY of Pittsburgh, Pa., recently bought the entire stock of the Pittsburgh Armature Works.

R. J. MORGAN, formerly supervisor of sales for the American Steel Export Company of New York City, has been appointed assistant general manager of sales.

THE PETTINGELL-ANDREWS COMPANY of Boston, Mass., will open a branch soon in the Back Bay for distributing storage batteries and automobile supplies.

THE EMIL GROSSMAN MANUFACTURING COMPANY of Brooklyn, N. Y., on Jan. 13 held a winter meeting of the salesmen and department heads. A luncheon was also held. The company's executive staff was present.

THE CHINA PRODUCTS' COMPANY of Zanesville, Ohio, has purchased the Virginian Potteries Company, its plant, manufactured products, tools, fixtures and raw materials. Possession was delivered to the new owners Jan. 30.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis, Mo., announces the opening of a service station at Seattle, Wash., to take care of this branch of its business in the State of Washington and the Northwest.

H. H. MILLER, formerly employed by the Doubleday-Hill Company, Pittsburgh, Pa., has accepted a position with the Square D Company of Detroit. Mr. Miller will cover the Pittsburgh territory, working in conjunction with D. M. Stone, manager of that district.

THE WESTINGHOUSE LAMP COMPANY of New York City has removed its advertising department from 165 Broadway (City Investing Building) to the Park Row Building, 21 Park Row, opposite the General Post Office. It has taken a suite of offices on the sixteenth floor.

P. C. GUNION has been made advertising manager of the industrial bearings division of the Hyatt Roller Bearing Company, Newark, N. J. Previous to his recent appointment he was manager of the company's office in Pittsburgh, Pa., and for two years was in the sales department.

FRANK J. FOLEY, formerly manager of the mining department of the Westinghouse Electric & Manufacturing Company, on Jan. 1 became connected with the Edison Storage Battery Company, Orange, N. J., as manager of the mining and traction department, with headquarters at the main office.

THE ESTERLINE COMPANY of Indianapolis, Ind., announces the appointment of the F. R. Jennings Company, 616 Ford Building, Detroit, Mich., as its sales representative for graphic instruments for Michigan. Mr. Jennings will handle that entire State for the Esterline Company, with the exception of the northern peninsula, which is taken care of by the Milwaukee office.

THE ERNER-HOPKINS COMPANY, Columbus, Ohio, held its annual sales conference and dinner in the Athletic Club rooms on Jan. 10. Twenty-seven men were present. Addresses were made by M. A. Pixley, vice-president and general manager; J. T. Dunnick, secretary, and V. G. Eastman, sales manager. Reports of the officers showed that the company had enjoyed one of the best years in its history.

C. H. SANDERSON, formerly assistant chief engineer of the Havana Electric Railway, Light & Power Company, Havana, Cuba, is now manager of the auto and truck departments of the Frank G. Robbins Company of New York and Havana. Mr. Sanderson will handle gasoline and electric pleasure cars and trucks, as well as storage batteries, and will also be in charge of the garage, machine shops and charging station in Havana and the sales and service work for the entire island.

THE MERCHANTS' ASSOCIATION of New York City has issued in pamphlet form a report of five conferences between employers and representatives of the British Ministry of Munitions. It is entitled "Readjustment and Operation of Industry in England Since 1914," and, besides the conference details referred to, it also gives a summary of five additional conferences between a special commission from the British government and many employers of New York City, northern New Jersey and Connecticut. Copies may be had on application to the Merchants' Association.

THE WESTERN ELECTRIC COMPANY of New York City about the middle of the month will remove its distributing staff—clerical and heads of departments—from 483 West Street to the Broadway-Fifth Avenue Building, 921-925 Broadway and 149-151 Fifth Avenue, at Twenty-first Street. The company will occupy the thirteenth, fourteenth, fifteenth and sixteenth floors, comprising an area of about 45,000 sq. ft. The engineering department of the local company was cramped for room, and in order to provide for its expansion additional quarters were required. The new place is leased for a term of years.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY held its annual pre-holiday meeting on Dec. 24, 1917, at the Aiken Institute, Chicago. The annual meeting day has for several years been a sort of holiday. More than 500 persons attended the meeting this year. The remembrance to each employee was based on a Christmas present of $5, plus $1 for each year the employee had been in the service of the company. A few were present who received $20 in their envelopes, which marks the extreme length of service, for the Benjamin company is a little more than fifteen years old. R. B. Benjamin, president, and W. D. Steele, vice-president and general manager, addressed the employees.

Trade Publications

SALES SERVICE.—The Society for Electrical Development, Inc., New York City, is distributing the February number of its *Monthly Sales Service*.

INDUSTRIAL TRUCKS.—The Enterprise Machine Works of Los Angeles, Cal., have prepared a folder descriptive of their electric industrial floor trucks and tractors.

MOTOR EQUIPMENT.—Motor equipment for textile service is described in leaflet 3910, prepared by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

LIGHT CONTROLLER.—The Barrett automatic light controller for Ford cars is described in a leaflet prepared by the American Sales Corporation, 614 Fulton Building, Pittsburgh, Pa.

MOTOR-GENERATOR SETS.—The Electric Specialty Company, Stamford, Conn., has prepared its bulletin No. 212, descriptive of its motor-generator sets for battery charging and signal work.

VACUUM PUMPS.—Bulletin 52, descriptive of Rees roturbo patent rotary jet vacuum pumps for surface condensers, is being distributed by the Manistee Iron Works Company of Manistee, Mich.

FLOOR-POLISHING MACHINE.—The Dale-Rey Corporation, 25 Church Street, New York City, has prepared a circular descriptive of its electric polishing machine for waxed floors of wood or linoleum.

LAMP PRICE SCHEDULE.—The Westinghouse Lamp Company is distributing its new price schedules effective Jan. 1, 1918. This schedule includes list-price changes on Mazda and metallized-filament lamps.

LOCOMOTIVES.—The Baldwin Locomotive Works of Philadelphia, Pa., are distributing record No. 88, descriptive of their Santa Fe type locomotives. They have also prepared record No. 89, descriptive of the development of the eight-driving-wheel locomotive.

GENERATORS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has prepared leaflet 3555-A, descriptive of its self-contained vertical shaft alternating-current generators. This company has also prepared leaflet 2000, giving information regarding its 10-kw. direct-current turbine-generator.

AUTOMOTIVE EQUIPMENT.—A special publication descriptive of starting motors, lighting generators and ignition units for automobiles, trucks, tractors, airplanes, motor boats and locomotives has just been issued by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. This gives a general description of the Westinghouse starting motor for engines of piston displacement from 200 cu. in. to 1000 cu. in., and of Westinghouse generators of capacities from 15 amp. to 25 amp. at 6.5 volts to 13.0 volts. Among the latter are included the new cam-regulated generators which are being used on military and commercial trucks and on farm tractors. Generators thus regulated will give constant voltage over a wide range of speed even though the battery is disconnected from the circuit. The book is profusely illustrated with views of the apparatus and its various parts, and tables giving the necessary data for application are included.

New Incorporations

THE CLINTON (TENN.) POWER COMPANY has been incorporated with a capital stock of $20,000 by R. A. Moser, J. W. Hill, H. D. Hicks and others.

THE MERIDIAN ELECTRIC COMPANY of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 by J. A. F. and E. M. Keppel of Ebenezer.

THE CONNOQUENESSING LAWRENCE LIGHT & POWER COMPANY of New Castle, Pa., has been incorporated with a capital stock of $10,000 to operate a local plant. E. G. Dunlap is one of the incorporators.

THE GAS ENGINE & ELECTRIC COMPANY of Charleston, S. C., has been incorporated by H. Stevens White, A. D. Wall and J. Ewing Bonneau. The company is capitalized at $50,000 and proposes to manufacture gas engines.

THE CUTHBERT COMPANY of Dayton, Ohio, has been organized with a capital stock of $500,000 by Charles S. Hall of the Hall Electric Company of Dayton and others. The company proposes to manufacture electrical devices.

THE STENMAN ELECTRIC VALVE GRINDING COMPANY of Worcester, Mass., has been incorporated with a capital stock of $50,000. The officers are: B. F. Stenman, president, and Albert W. Larson, 10 Conway Street, treasurer.

THE HANAK CONVEYOR COMPANY of Houston, Tex., has been incorporated with a capital stock of $5,000 by Edward Hanak, J. G. Belton and Robert Kornbeck. The company proposes to manufacture conveyors and trolley systems.

THE GUIDE & SIGNAL LIGHT COMPANY of Indianapolis, Ind., has been incorporated by Richard McClellan, L. Greenburg and Robert Eaglesfield. The company is capitalized at $100,000 and proposes to manufacture electrical devices.

THE INVENTIONS BOARD, INC., of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing wireless apparatus. The incorporators are: P. D. Strogoff, O. B. and M. Wiren, 5 Nassau Street, New York City.

THE UNITED ELECTRIC SUPPLY CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $20,000 to manufacture electrical machinery of all kinds. The incorporators are: F. M. Byrne, J. F. Byrne and H. H. Byrne.

THE UNEEDUS MERCANTILE CORPORATION of New York, N. Y., has been incorporated with a capital stock of $30,000 by I. E. A. Konigsberg, H. J. Lucke and S. M. Bender, 2 Rector Street, New York City. The company proposes to manufacture telephone and acoustic apparatus.

THE SUN-LIGHT ARC COMPANY of New York, N. Y., has been incorporated by M. M. Eisenberg, E. M. James, 2 Rector Street, New York City, and A. C. Head, 181 Martense Street, Brooklyn, N. Y. The company is capitalized at $300,000 and proposes to manufacture patented arc lamps.

THE EVANWOOD BATTERY CORPORATION of Buffalo, N. Y., has been chartered with a capital stock of $500,000 by H. E. Evans, H. J. Wood, 1358 Main Street, Buffalo, N. Y., and R. H. Templeton, 428 Ashland Avenue, Buffalo. The company proposes to manufacture chemical electric batteries.

THE BOSTON INSULATED WIRE & CABLE COMPANY of Hamilton, Ont., has been chartered with a capital stock of $200,000 to manufacture cables, wire, etc. The incorporators are: Benjamin T. Burley of Worcester, Mass.; Harry B. Burley of Brookline, Mass.; Grant W. Arnold of Hamilton and others.

NATHAN A. KRISCHER of New York, N. Y., has been incorporated by N. A. Krischer, M. Krischer, 30 West 112th Street, New York City, and J. Weinstock, 1459 Minford Place, the Bronx. The company is capitalized at $50,000 and proposes to manufacture metal and leather goods and novelties and gas and electrical supplies.

THE MONTGOMERY TRANSIT & LIGHT COMPANY of Norristown, Pa., has filed articles of incorporation under the laws of the State of Delaware to construct and operate electric railways and light plants. The company is capitalized at $1,000,000, and it is understood that it will take over the Montgomery Transit Company, which operates a railway from Norristown to Harleysville, a distance of 13 miles.

New England States

LENOX, MASS.—Application has been made to the State Gas and Electric Commission by the Lenox Electric Company for permission to issue $51.000 in capital stock the proceeds to be used for additions and extensions to its system.

PLYMOUTH, MASS. — The Plymouth Electric Light Company is planning to extend its electric transmission line to Livermore Falls, a distance of 2 miles, to be completed June 15, 1918. A. F. Wentworth is treasurer.

DANBURY, CONN.—The National Electric Utilities Corporation has recently closed a contract with the Navy Department at Washington for 300 electric ovens to be used on Government vessels.

NORWICH, CONN.—At a special election held recently the voters authorized an appropriation of $200,000 for the installation of a 3000-kw. turbine and two 500-hp. boilers in the municipal electric-light plant; also an appropriation of $25,000 to install a new water-gas unit in the municipal gas plant.

WATERBURY, CONN. — The Mattatuck Manufacturing Company is contemplating the construction of a boiler house.

Middle Atlantic States

ALBANY, N. Y.—Bids will be received at the office of W. W. Wotherspoon, superintendent of public works, Capitol, Albany, until Feb. 5 for barge canal work, including construction of additional protection work in by-passes at lock and barge canal terminal, furnishing fourteen 2-ton steam tractor cranes, building freight house and four electrically operated timber derricks.

BROOKLYN, N. Y.—Contracts have been awarded for the construction of a new power plant, 55 ft. by 105 ft., at the Brooklyn Naval Hospital.

BUFFALO, N. Y.—The City Council has approved a bond issue of $60,000 for the purpose of placing the wires of the police and fire departments underground.

GROTON, N. Y.—The Groton Electric Power Corporation, which has leased the municipal electric-light plant, is installing a 250-hp. Erie boiler. W. E. Yates is engineer of the power station.

NEW YORK, N. Y.—The J. F. & M. B. Construction Company is considering the construction of a new power house at 1562 Odell Street, the Bronx, in the near future.

NEW YORK, N. Y.—Plans have been filed by the New York Edison Company, 130 East Fifteenth Street, for the construction of a new transformer station at Park Avenue, near 189th Street, to cost about $15,000. Contract has been awarded to the Louis Weber Building Company, 171 Madison Avenue, New York City.

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 11, for piping and accessories, turbine-driven centrifugal pump, structural steel foundations and miscellaneous work in connection with the installation of new equipment in the central power plant at the navy yard, New York. Drawings and specifications (No. 2794) may be obtained on application to the above bureau or to the commandant of the navy yard named.

NIAGARA FALLS, N. Y.—Plans have been filed by the Oldbury Electric Chemical Company, Buffalo Avenue, Niagara Falls, for the erection if a new reinforced concrete addition to power house. The building will be about 35 ft. by 65 ft., and will cost about $15,000. Contract has been awarded to G. W. Moyer & Son, 633 Tenth Street, Niagara Falls.

OXFORD, N. Y.—Bids will be received by Mrs. Georgiana Griffith, president of board of managers, of the New York Woman's Relief Corps Home, Griffith, until Feb. 13 for refrigeration plant. Drawings, specifications and blank form of proposals may be consulted and copies obtained at the Department of Architecture, Albany, the New York City office of the Department of Architecture, Woolworth Building, or at the home, Oxford, N. Y.

CAMDEN, N. J.—Plans have been filed and contract awarded to the Holbrook Cabot Rollins Company of Camden by the New York Shipbuilding Company for the construction of a new power house, 45 ft. by 95 ft., at its works at Broadway and Fairview Street.

DOVER, N. J.—The New Jersey Power & Light Company has entered into a contract with the International High Speed Steel Company for furnishing electricity for motors, lamps and electric furnaces at the plant of the steel company.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

FRANKLIN, N. J.—The installation of a new electric fire alarm system is under consideration by the Borough Council.

NEWARK, N. J.—The Board of Freeholders has awarded the contract for electric and power wiring at the County Hospital at Overbrook to the Beaver Engineering Company, 59 Mechanic Street, at $14,174. Extensive improvements to the heating system at the institution are under consideration, to cost about $75,000.

SKILLMAN, N. J.—Contract has been awarded by the Philadelphia & Reading Railroad Company of Philadelphia, Pa., to A. L. Carhart, of Philadelphia, Pa., for the construction of a power house and signal tower in Skillman, to cost about $40,000.

SUCCASUNNA, N. J.—The New Jersey Power & Light Company of Dover has begun work on the installation of a new street-lighting system from Kenvil to Succasunna.

WHARTON, N. J.—The New Jersey Power & Light Company has submitted a contract (renewal) to the Borough Council for lighting the streets of the borough for a period of five years.

ASHLEY, PA.—Contract has been awarded by the Central Railroad Company, 143 Liberty Street, New York, N. Y., for the construction of an addition, 70 ft. by 70 ft., to its power plant at Ashley.

BENNINGTON, PA.—Contract has been awarded by the Pennsylvania Railroad Company for the erection of a new signal tower 15 ft. by 25 ft., two stories, to P. W. Finn & Son, of Altoona, Pa.

HARRISBURG, PA.—The City Commission is considering the installation of a new electrically-driven pump and motor at the municipal pumping station. Improvements to the electric fire-alarm system are also under consideration.

KUTZTOWN, PA.—At an election held recently the proposal to appropriate $15,000 to complete the municipal electric-lighting plant was carried.

NEW BLOOMFIELD, PA.—Plans are being considered by the New Bloomfield Hosiery Mills for equipping its plants for electrical operation, to replace steam power.

PHILADELPHIA, PA.—The Colver Electric Company has filed notice with the Public Service Electric Company of an issue of $25 000 in capital stock, the proceeds to be used for improvements, etc.

PHILADELPHIA, PA.—The Tioga Steel & Iron Company, Fifty-second Street and Gray's Ferry Avenue, has awarded contract for the erection of an addition to its power house, to cost about $8,000, to Crowell, Lundorff & Little Company of Philadelphia.

PHILADELPHIA, PA.—Bids will be received by William S. Twining, director department of city transit, City Hall, Philadelphia, Pa., until Feb. 14 for electrical installations in station buildings at Torresdale Avenue and Tioga Street, under contract No. 542. Plans and specifications can be seen at Room 748, Bourse Building, and copies obtained, with blanks for proposals, upon deposit of $10, which will be refunded upon return of plans.

READING, PA.—Notice has been filed by the Metropolitan Edison Company with the Public Service Commission of an issue of $97,500 in bonds, the proceeds to be used for improvements, extensions, etc.

FAIRMONT, W. VA. — George W. F. Mulliss of Martinsburg, agent of the Interwoven Mills at Fairmont, would like to receive estimates on electrical equipment for installation at Fairmont.

TIMBERVILLE, VA.—The local electric-light plant, owned by the estate of the late Charles E. Fahrney, has been purchased by Hoover Brothers.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 18, under specification (No. 2760) for mechanical equipment for power plants at Norfolk and Philadelphia navy yards.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 1671—miscellaneous leaded and armored interior communication cable, 145 000 ft. plain single-conductor wire; Schedule 1670—630,000 ft. incandescent lamp cord, 115,000 ft. rubber-insulated, lead-covered wire, miscellaneous duplex, single-conductor, rubber-covered wire, 120,000 ft. rubber-insulated telephone wire, 130,000 ft. twin-conductor wire. Schedule 1669—miscellaneous 12-in. desk and bracket fans. Application for proposal blanks should give the schedule desired by number.

North Central States

GRAND RAPIDS, MICH.—Preparations are being made by the City Council for the construction of a 300,000-gal. concrete reservoir for which bids will be advertised for next month. F. H. Leonard is superintendent of the light and water plant.

LOWELL, MICH.—The town of Lowell expects to take over the water-works system March 1. T. J. McMahon is superintendent of the municipal electric-light plant.

MUNISING, MICH.—The Electric Light & Power Company of Munising contemplates running a submarine cable to Grand Island, a distance of 1 mile, from the end of its service line. James Hosking is vice-president and manager.

MELBOURNE, KY.—Contracts have been awarded by the Sisters of Providence for the electric wiring of the administration building and mother house to Tissber Brothers of Covington. The cost of the building is estimated at $200,000.

DECATUR, IND.—Contracts have been placed for one 500-kw. General Electric turbo-generator, with barometric jet condenser, to be installed in the municipal electric-light plant in the spring. R. G. Christin is clerk.

INDIANAPOLIS, IND. — The capital stock of the Standard Machine & Electric Company has been increased from $75,000 to $100,000.

MARION, IND.—The Delta Electric Company has increased its capital stock from $90,000 to $115,000.

MARION, IND.—The Indiana Public Service Commission has authorized the Indiana General Service Company, controlled by interests represented by R. E. Breed, of New York, N. Y., to purchase the properties of the Marion (Ind.) Light & Heating Company and the Muncie (Ind.) Electric Light Company.

BONDVILLE, ILL.—The Bondville Electric Light Company is considering the installation of power service for one or two elevators, which would require 20 hp. in motors each. The company would like to receive information and prices on equipment for same. Jay C. Flowers is secretary.

HOMER, ILL.—The Homer Electric Light & Power Company, recently taken over by J. M. Capel and others of Champaign, has been reorganized under the name of the Homer Electric Light Company. The new company is capitalized at $30,000.

SOUTH BEND, ILL.—The building occupied by the Indiana & Michigan Electric Company was recently destroyed by fire, causing a loss of about $120,000.

SWANSEA, ILL.—The municipal electric-light plant was recently destroyed by an explosion causing a loss of about $15,000. Post office address, Belleville, Ill.

WOODLAWN, ILL.—The Southern Illinois Light & Power Company of Hillsboro has applied to the Public Utilities Commission for a certificate of convenience and necessity to operate an electric light and power plant at Woodlawn.

BLOOMER, WIS.—The City Council is considering the question of establishing a municipal electric-light and power plant.

DE SOTO, WIS.—The village of De Soto is considering the construction of a municipal electric-light plant.

HARTFORD, WIS.—Bids will be received by A. Martin, city engineer, until Feb. 19 for a deep-well pump and a two-phase, 60-cycle alternating-current motor, switchboard and temporary connections with water mains.

LAKE GENEVA, WIS.—Bids will be received until Feb. 4 for the erection of an electric line on Clover and Pleasant Streets west of Conant Street to the city limits.

SHAWANO, WIS.—Plans are being considered by the Shawano Lumber Company for the construction of a new lumber mill, to be equipped throughout for electrical operation, to cost about $30,000.

STOUGHTON, WIS.—The Porter Electric Line Company, recently incorporated, it is reported, will erect an electric transmission line to connect with the Stebbinsville-Stoughton conduit system. The proposed line will be about 10½ miles long, and will extend from Dunkirk to the Cooksville-Edgerton Road, and from there to Cooksville, and thence to Tolles Corner.

WEST ALLIS, WIS.—The Board of Education, it is understood, will soon ask for bids for the construction and equipment of a high school and manual training institute. The building will be 176 ft. by 277 ft., three stories and basement, with a separate boiler house, to cost about $200,000.

BROOTEN, MINN.—The installation of a 25-hp. oil engine and a 15-kw. generator to take the place of the present storage battery in the municipal electric-light plant is under consideration by the Town Council. F. W. Sonnenberg is superintendent.

GLYDON, MINN.—Arrangements are being made by the Glydon Light Company for the installation of additional street lamps. H. C. Boyle is secretary.

HIBBING, MINN.—The city of Hibbing is contemplating the construction of a new municipal electric plant, to cost about $500,000. G. L. Thauin is secretary of water and light commission.

MILAN, MINN.—The Milan Light & Power Company contemplates the installation of a complete new storage battery in the spring. Messrs. Haughland & Kanten are owners.

PINE RIVER, MINN.—The Pine River Electric Light & Power Company expects to install a steam plant in the near future. Upon completion of the proposed new plant a 23-hour service will be established. T. L. Arvig is secretary and superintendent.

PIPESTONE, MINN.—Laundry, power plant and pumping system at the Pipestone Indian Training School were recently destroyed by fire, causing a loss of about $25,000.

AMES, IOWA.—A new 600-kw. General Electric 2200-volt, three-phase, 60-cycle turbine is being installed in the municipal electric-light and water plant. A. F. Hill is manager.

INDEPENDENCE, IOWA.—Plans are being considered for an addition to power house at the State Hospital for Insane, for which, it is reported, bids will be asked in the spring. New equipment, including one generator and two boilers, will be installed. H. T. Liebbe, State House, Des Moines, is architect.

PERRY, IOWA.—Bids will be received by the city of Perry until Feb. 15 for one 60-kva., two-phase, 60-cycle, 220-volt generator, directly connected to engine, to be installed at the municipal waterworks. Specifications may be obtained at the office of the city clerk. Adrian Cross is city clerk.

WATERLOO, IOWA.—Application has been made to the Board of Railroad Commissioners by the Citizens' Gas & Electric Company of Waterloo for a franchise to erect electric transmission lines to adjoining counties and towns.

BUCKLIN, MO.—The property of the Bucklin Light & Power Company has been purchased by H. A. Spradling, of Marceline.

KAHOKA, MO.—Plans are being considered to extend the electric transmission lines of the municipal electric-light plant to Luray, Williamstown, Clark City and Medill in the spring. L. R. Sherrill is superintendent.

OREGON, MO.—The city of Oregon is planning to secure electricity from St. Joseph to operate the municipal electric-system and will erect a transmission line at once.

FULLERTON, N. D.—The Ellendale (N. D.) Electric Company has been granted a franchise to erect electric transmission lines from its Ellendale plant to Fullerton and Monango. G. F. Phillips is treasurer and manager of the company.

NOME, N. D.—The City Council is considering the installation of an electric-lighting system.

AINSWORTH, NEB.—The Ainsworth Light & Power Company has secured a contract to supply electricity in Bassett, and will erect an electric transmission line to Long Pine, where it will connect with the line to be built by the Bassett Distributing Company. W. V. Finney is manager.

ARLINGTON, NEB.—The Arlington Light, Heat & Power Company is contemplating the installation of a kerosene engine and changing its system from single phase, 125 cycles, to three phase, 60 cycles, 2200/110-220 volts. M. E. Winset is manager.

BENKELMAN, NEB.—The Council is considering the purchase of a 12-kw. generating unit (for engine service) soon for the municipal electric-light plant. J. R. Hardisty is manager.

BROADWATER, NEB.—The Broadwater Electric Light & Power Company is planning to install a new generating unit, consisting of a 50-hp. oil engine and a 35-kw., 125-volt direct-current generator. T. F. Black is engineer.

ERNST, NEB.—The Meyer Hydro Electric Power Company is considering extending its electric transmission lines to Nelson, Ong, Shickley and Belvidere. Ernst Meyer is president and manager.

LONG PINE, NEB.—S. H. Kyner, owner of the local electric-light and power plant, is considering the installation of a 100-kw. generator, switchboard and one 20-hp. motor at his power plant; also two pumps and constructing about 4000 ft. of water main from city main to plant.

PIERCE, NEB.—The Pierce Milling Company is rebuilding its power house and installing an additional 50-kva. generator, to be driven by water power and a new 250-hp. Corliss steam engine. Frank E. Drebert is manager.

RED CLOUD, NEB.—The city of Red Cloud has rebuilt part of its pole line system to Riverton and Inavale, and is now erecting a single-phase transmission line to Inez. C. Z. Woodworth is superintendent.

SCHUYLER, NEB.—Plans are being considered by the City Council to rebuild the municipal electric-light plant. It is proposed to replace the present direct-current apparatus with an alternating-current equipment. E. A. Schmid is manager.

SIDNEY, NEB.—Improvements are contemplated to the municipal electric-light plant during 1918, including the installation of a 200-hp. boiler and a 150-kva. generator and engine. J. E. Poquette is manager.

STRATTON, NEB.—Improvements to the municipal electric-lighting system in the near future, including the installation of a 20-hp. semi-Diesel engine and a 10-kw. generator, are under consideration. Elmer Martin is engineer.

ARCADIA, KAN.—An electric transmission line will be erected from Arcadia to Oskaloosa to supply electricity to operate the local system, owned by Phillip R. Tohl.

CHARDON, KAN.—At an election held recently the proposal to issue $25,000 in bonds for the installation of a new electric-light plant was carried.

COLBY, KAN.—Bonds to the amount of $30,000 have been voted for improvements to the municipal electric-light plant.

GARFIELD, KAN.—The Kinsley Electric Light & Power Company has secured a contract to supply electricity in Garfield. An item published in the issue of January stated that local business men had entered into a contract for electricity from the municipal electric plant in Larned. A. L. Moe is owner and manager of the Kinsley Electric Light & Power Company.

HUGOTON, KAN.—The Liberal (Kan.) Light & Power Company is contemplating extending its electric transmission line to Hugoton to furnish electrical service here.

Southern States

CARROLLTON, GA.—Plans are being considered to double the output of the yarn mill of the Mandeville Mills. Four frame type motors having total capacity of 450 hp. will be purchased.

SAVANNAH, GA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 15 for furniture, lighting and repairs to conduit and wiring in the United States post office at Savannah. Drawings and specifications may be obtained at the above office.

MIAMI, FLA.—The Miami Traction Company is considering the construction of an electric railway between Miami and Miami Beach.

CHATTANOOGA, TENN.—The Tennessee Power Company, it is reported, contemplates additional hydroelectric developments and erection of transmission line extensions to prepare for supplying electricity to the explosive manufacturing plant the government will build at Hadley's Bend.

CLINTON, MISS.—Preparations are being made by the Town Council to install an oil-burning outfit in the municipal electric-light plant, but as yet it has been unable to secure an engine. M. Latimer is Mayor.

HOMER, LA.—Preparations are being made to drill another well to double the output of the water supply of the municipal water-works system. W. A. McKinzie is superintendent of the municipal water and light plant.

BRISTOW, OKLA.—The City Council has decided to call an election to submit the proposal to issue $36,000 in bonds for the purchase of the local electric-light and power plant to be owned and operated by the municipality.

CANYON, TEX.—The plant of the Canyon Power Company was recently damaged by fire.

DALLAS, TEX.—The Dallas Light & Power Company is contemplating erecting an electric transmission line from its local plant to Norwood.

HOUSTON, TEX.—The Houston & Texas Railway Company is contemplating the construction of an interlocking signal tower, 24 ft. high, at a cost of about $16,000. L. A. Collingham is engineer.

Pacific and Mountain States

ELLENSBURG, WASH.—Application has been made to the Board of County Commissioners by Henry C. Mills for a franchise to erect and operate electric transmission lines on highways throughout the county for a period of 50 years.

SEATTLE, WASH.—Plans have been completed for the erection of a boiler shop, 180 ft. by 269 ft., for the Puget Sound machinery depot, to cost about $75,000.

SEATTLE, WASH.—Bids will be received by the Board of Public Works, Seattle, until March 1 for construction of the proposed hydroelectric power plant to cost $5,000,000. Bids may be submitted by either owners of sites or contractors in conjunction with owners of sites. It is probable that bids will be submitted on construction of a plant on the site to which the city of Seattle has just secured from the Government full rights on the Skagit River.

SPOKANE, WASH.—The erection of a charging plant for rebuilding electrical machinery and charging storage batteries is under consideration by the Chase Engineering Company.

PENDLETON, ORE.—Improvements are contemplated by the Pendleton Roller Mills involving an expenditure of about $10,000, and will include the installation of dump scales, conveyor belts and other improvements.

SAN FRANCISCO, CAL.—Work has begun on the construction of the shipbuilding plant of the Pacific Coast Shipbuilding Company at Bay Point. The buildings will include a plate shed, 80 ft. by 400 ft., two stories; machine shop, 120 ft. by 400 ft., one story, a large warehouse, power house, an office building, planing mill, etc. The launching ways will be 500 ft. long, 53 ft. wide, with 95 ft. clearance between. Aerial trolleys will be used for the transportation of supplies. The cost of the plant is estimated at $500,000.

KINGMAN, ARIZ.—The Desert Power & Light Company is planning to extend its electric transmission lines to Hackberry and to Cyclopic.

BRIDGER, MONT.—The Bridger Water & Light Company contemplates changing its system from direct to alternating current, provided equipment can be secured. J. S. Emmett is secretary and treasurer.

Canada

BANFF, ALTA.—The Alberta Electro-Chemical Company is contemplating the installation of machinery at its plant at Kananaski Falls, Alberta, for the manufacture of carbide, etc. Dr. Harry Brett of Banff is in charge.

PRINCE RUPERT, B. C.—The Prince Rupert Hydro-Electric Company has submitted a proposal to the City Council offering to sell the Falls River plant, including improvements, to the city of Prince Rupert, for $34,000.

SYDNEY, N. S.—The Cross Fertilizer Company, Prince Street, it is reported, will rebuild its mill and engine room, recently destroyed by fire, at once. The cost is estimated at $20,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 11 for furnishing soft steel, structural steel, plate steel, 100 ft. black pipe, transformers 15,000 ft. cable, copper wire, 3000 ft. conduit, 645 fixtures, one electric range, 600 reflectors, 75 resistance units, one feed pump, three hoist blocks, etc.

PANAMA.—Bids will be received at office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 6 for furnishing mill work for ordnance shop, two annunciators, 19 porcelain blocks, brass junction boxes, 50 vibrating bells, 100 push buttons, 50 buzzers, tinned copper cable, 25 fans, 150 glass tube fuses, miscellaneous electric fixtures, 150 marine globes, electrical supplies, receptacles, sleeves, stuffing tubes, terminal boxes, conduit tubes, desk tubes, etc.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom, 29 South La Salle St., Chicago. Annual meeting, May 14, 1918.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia,.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary-treasurer, Roy B. Fowles, Pine Bluff, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, George C. Holberton, San Francisco, Cal.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, McKeesport, Pa. Annual convention, September, 1918.

ASSOCIATION OF RAILWAY EELCTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, W. L. Connelly, Gibson, Ind.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, R. B. W. Pirie, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, September, 1918.

CALIFORNIA ASSOCIATION OF CONTRACTORS AND DEALERS. Secretary, James W. Redpath, 505 Rialto Bldg., San Francisco, Cal.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, M. C. Gilman, Toronto Electric Light Company.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION N. E. L. A. Secretary, F. D. Beardslee, Union Electric Light & Power Co., St. Louis, Mo.

CONNECTICUT ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, George M. Chapman, Waterbury, Conn. Annual meeting, New Haven, Conn., May, 1918.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert E. Elliott, 502 Flatiron Building, San Francisco.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, L. W. W. Morrow, Norman, Okla. Annual meeting, May, 1918, Oklahoma City.

GEORGIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, Dan Carey, Atlanta Builders' Exchange, Atlanta, Ga. Annual meeting, June, 1918, Tybee Island, Ga.

ILLINOIS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. B. Van Nuys, Central Electric Co., Peoria, Ill.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, R. H. Abbott, Petersburg, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INDIANA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, George Skillman, Indianapolis, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, David Sarnoff, 111 Broadway, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, M. T. Humphrey, Waterloo, Iowa.

IOWA SECTION, N. E. L. A. Secretary-treasurer, L. E. Caldwell, Iowa City, Iowa.

JOVIAN ORDER. Jupiter (president), Henry J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, R. M. Sutton, Wichita.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan. Annual meeting, Kansas City, Kan., Oct. 17-19, 1918.

KENTUCKY ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary, F. F. Valinoti. Annual meeting, May, 1918, Louisville, Ky.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 323 Chartres St., New Orleans, La.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Augusta, Me.

MASSACHUSETTS ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, J. E. Wilson, 263 Summer St., Boston, Mass.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Monroe, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, H. E. Young, Minneapolis General Electric Company, Minneapolis, Minn.

MINNESOTA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, G. M. Jones, 112 South Seventh St., Minneapolis, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, W. F. Wheeler, Hattiesburg.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis.

MISSOURI ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo.

NATIONAL ARM, PIN AND BRACKETT ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, H. C. Brown, 41 Martin Building, Utica N. Y.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Concord, Mass. Annual convention, New York, March, 1918.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRICAL CREDIT ASSOCIATIONS Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill. Annual meeting, June 1, 1918.

NATIONAL FIRE PROTECTION ASSOCIAT.ON. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, E. A. Thiele, Roswell. Annual meeting, Silver City, N. M., Feb. 11-13.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York. Annual meeting, June, 1918.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore. Annual meeting, Sept. 11, 1918.

NORTHERN WHITE CEDAR ASSOCIATION. Secretary, N. E. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OREGON ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, J. W. Oberender, 302 Dekum Building, Portland, Ore. Annual meeting, September, 1918.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, Crossley Building, San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PENNSYLVANIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, M. G. Sellers, 1518 Sansom St., Philadelphia.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General Manager, J. M. Wakeman, 29 West 39th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual meeting, Evanston, Ill., June, 1918.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, Frederick D. Brown, Huron, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga. Annual meeting, June 19-20, Atlanta, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex. Annual meeting, April, 1918.

TEXAS STATE ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary, H. S. Ashley, Fort Worth, Tex. Annual meeting, Galveston, Tex., June 15, 1918.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. E. Myers, 3 Gould St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Charlotte, N. C., April, 1918.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, C. H. West, Rutland, Vt. Annual meeting, February, 1918.

VIRGINIA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. M. Andrews, Richmond.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 W. Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, 1410 First National Bank Building, Milwaukee, Wis. Annual meeting, March, 1918.

WISCONSIN ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, J. C. Staff, 578 Jackson St., Milwaukee, Wis.

(Issued Jan. 1, 1918.)

1,251,848. Electrically Operated Switch; Theodore Varney and Howard L. Beach, Pittsburgh, Pa. App. filed June 28, 1911. Necessity for heavy and expensive switchboard panels is avoided.

1,251,856. Electric Switch; Carl Barr, Chicago, Ill. App. filed March 26, 1917. Improved clip for co-operation with the knife of an ordinary knife switch in order to complete or break an electric circuit.

1,251,867. Automatic Carriage Return for Typewriters, Line Spacers and Reverse Tabulators; Thomas F. Crawley, Newton, Mass. App. filed Oct. 16, 1915. Improvements.

1,251,572—Electrical Protective Apparatus

1,251,940. Automobile Signal; James J. Ulch, Des Moines, Iowa. App. filed July 13, 1916. Electrically operated.

1,251,967. Call-Answering Meter for Cord Circuits; Hiram D. Currier, Chicago, Ill. App. filed Sept. 19, 1914. Improved apparatus for actuating such a meter.

1,251,982. Multiple-Phase-Motor Regulating Resistance; Fredrik Ljungstrom, Finspong, Sweden. App. filed April 16, 1915. Resistances in which two conoidal or more or less funnel-form conducting parts and intervening fluid are employed to make the resistance.

1,251,983. Connection for Electric Conductors; James H. Lockwood, Bridgeport, Conn. App. filed Jan. 29, 1917. Improvement.

1,251,985. Automatic Switch; Frank A. Lundquist, Chicago, Ill. App. filed Feb. 12, 1917. Improvements.

1,251,988. Automatic Selective Switch; James L. McQuarrie, Montclair, N. J. App. filed Nov. 15, 1916. Controlling means.

1,251,991. Electric-Cord Protector; Claude R. Dodge, Salt Lake City, Utah. App. filed Nov. 2, 1916. Will also serve as a shock-absorbing means.

1,252,028. Telephone-Exchange System; Osvald E. Rasmussen, West Hoboken, N. J. App. filed Nov. 17, 1916. Improvements in automatic numerical switches used in automatic and semi-automatic telephone-exchange systems.

1,252,052. Locomotive; Norman W. Storer, Pittsburgh, Pa. App. filed Aug. 10, 1915. Quill drive.

1,252,056. Telephone Receiver; Naho Tannaka, Boston, Mass. App. filed Dec. 19, 1916. Improvements.

1,252,057. Telephone Transmitter; Naho Tannaka, Boston, Mass. App. filed Feb. 14, 1917. Improvements.

1,252,060. Electrical Regulator; Allen A. Tirrill, Pittsburgh, Pa. App. filed Oct. 5, 1911. Regulation is effected by adjustment of the field excitation of a dynamo-electric machine.

1,252,067. Holder for Light-Transmitting Bowls and Reflectors; Edwin L. White, Brooklyn, N. Y. App. filed June 13, 1917. Semi-indirect lighting effect.

1,252,110. Theft Detector for Automobiles and Other Vehicles; John H. Hills and Joseph M. Mason, Philadelphia, Pa. App. filed Jan. 9, 1917. Improvements.

1,252,141. Electric Fuse; Thomas E. Murray, New York, N. Y. App. filed Dec. 23, 1916. Tubular fuse case formed of struck-up sheet metal.

1,252,142. Method of Electrical Welding; Thomas E. Murray, New York, N. Y. App. filed Jan. 10, 1917. Improvements.

1,252,143. Electric Welding Machine; Thomas E. Murray and Harry R. Woodrow, New York, N. Y. App. filed Feb. 19, 1915. Welds in succession a plurality of joints between the bodies to be united.

Record of Electrical Patents

Notes on United States Patents

1,252,144. Process of and Apparatus for Welding Metal Bodies and for Annealing Said Bodies at the Welded Joint; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed April 24, 1917. Improvements.

1,252,145. Apparatus for Electrical Welding; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed May 5, 1917. An apparatus for electrical welding, comprising an electrode having an opening constructed to receive and fit upon one of the bodies to be welded and an electrode connected to the other of said bodies, the first-named electrode being of a material having greater electrical conductivity than said received body.

1,252,146. Method of and Apparatus for Electrically Welding Plates or Bars Together; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed July 13, 1917. Improvements.

1,252,147. Method of Electrically Making Openings of Desired Configuration in Metal Plates; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed Oct. 10, 1917. Improvements.

1,252,148. Method of and Apparatus for Electrically Dividing Metal Plates; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed Oct. 10, 1917. Improvements.

1,252,185. Diagram for Electrolytical and Electric-Osmotical Purposes; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Jan. 4, 1913. Improvements.

1,252,196. Combined Fire and Burglar Alarm; Arthur A. Taylor and Henry J. Schatz, Omaha, Neb. App. filed March 2, 1917. Improvements.

1,252,201. Electric Meter; Elihu Tomson, Swampscott, Mass. App. filed Oct. 10, 1914. Direct current.

1,252,203. Rheostat; William F. Valcke, Jr., Chicago, Ill. App. filed Oct. 30, 1916. For regulating the amount of current which is supplied to a lamp or other apparatus connected to the socket.

1,252,216. Telephone Toll Set; Clarence A. Anderson, Abilene, Kan. App. filed April 30, 1917. For small stations.

1,252,219. Bridging Device for Fuse Receptacles; Clarence A. Bates, Bridgeport, Conn. App. filed Jan. 21, 1916. Improved.

1,252,288. Signal; Charles W. Monahan, Pittsburgh, Pa. App. filed Jan. 31, 1917. For trains.

1,252,289. Method of Producing Integral Projections on Metal Plates; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed Oct. 4, 1917. Improvements.

1,252,290. Method of Localizing and Eliminating Imperfections in Electrically Welded Joints; Thomas E. Murray, New York, N. Y. App. filed Nov. 1, 1917. For eliminating imperfections due to make and break of the welding current.

1,252,312. Electromagnetic Actuator; Henry E. Warren, Ashland, Mass. App. filed March 7, 1913. For valves, circuit breakers, etc.

1,252,314. Metal Conduit for Electric Wires; Chauncey W. Abbott, Pittsburgh, Pa. App. filed Aug. 18, 1915. For application to a wall, ceiling or other exposed supporting surface.

1,252,317. Sewing-Machine Motor; Chester H. Beach, Racine, Wis. App. filed June 21, 1915. Improvements.

1,252,330. Automatic Train Stop; Adiel Y. Dodge, Chicago, Ill. App. filed Jan. 28, 1914. Capable of causing the brakes to be applied gradually, and such that it may be used also in connection with throttle-closing apparatus.

1,252,353. Insulating Support; Horace P. Liversidge, Philadelphia, Pa. App. filed March 9, 1917. Novel manner of fastening the base supports and metal tops to insulators.

1,252,372. Incandescent Lamp; William A. Darrah, Mansfield, Ohio. App. filed July 31, 1914. Increases the efficiency of incandescent lamps by reducing the loss of heat by the continuous passage of a relatively hot filament or the radiating element of the lamp.

(Issued Jan. 8, 1918.)

1,252,393. Thermostatic Circuit Controller; Charles R. Burlew, Yonkers, N. Y. App. filed March 22, 1915. Wheel-like construction is preferably provided.

1,252,399. Telephone Exchange; Henry P. Clausen, Mount Vernon, N. Y. App. filed April 12, 1917. In which a plurality of subscribers' stations are connected to the same line circuit.

1,252,403. Electric Fixture; David Conlan, Jr., New York, N. Y. App. filed Nov. 8, 1915. Does away with the necessity for splicing and soldered joints now employed in making connections at outlet boxes between main and branch connectors.

1,252,413. Protective Device for Electric Circuits; Lewis E. Dickinson, Boonton, N. J. App. filed Nov. 6, 1916. Heat coils.

1,252,417. Electric Switch; Evald O. Engelke, Cleveland, Ohio. App. filed March 21, 1917. Improvements.

1,252,427. Transmission System; Charles L. Goodrum, New York, N. Y. App. filed Oct. 8, 1915. For establishing communication between a moving train and a central or dispatcher's station.

1,252,443. Process of Making Metals in Electric Furnaces; Ernest Humbert, Welland, Ontario, Canada. App. filed April 26, 1917. For producing a metal containing a certain percentage of carbon in the electric furnace.

1,252,451. Voltage Regulator; Charles H. Kicklighter, Pasadena, Cal. App. filed June 16, 1911. Improved automatic voltage regulator which may be employed in connection with any of the well-known forms of arrangements for controlling alternating-current circuits.

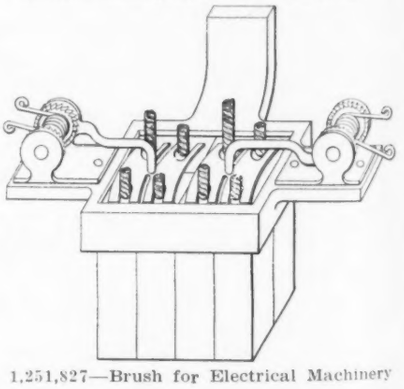
1,252,462. Automatic Switching Mechanism; Frank A. Lundquist, New York, N. Y. App. filed Aug. 16, 1916. Panel type.

1,252,492. Entrance Switch; Clarence D. Platt, Bridgeport, Conn. App. filed March 3, 1917. Inclosed type of switch.

1,252,493. Inclosed-Switch Construction; Clarence D. Platt, Bridgeport, Conn. App. filed April 6, 1917. Means for permitting locking of the switch in the open-circuit position.

1,252,498. Electric Switch; Sidney Sampson, Duluth, Minn. App. filed Jan. 30, 1917. Disconnecting knife-blade switch.

1,252,502. Protective Circuit; Hebert F. Shreeve, Millburn, N. J. App. filed Feb. 9, 1915. Provides an auxiliary protection against excess current which shall be effective during such period as the main current-limiting device is ineffective.



1,251,827—Brush for Electrical Machinery

1,252,504. X-Ray Apparatus; Homer C. Snook and George H. White, Haverford, Pa. App. filed May 26, 1915. Improvements.

1,252,560. Electric Switch; Clarence T. Evans, Milwaukee, Wis. App. filed Dec. 15, 1914. Snap switch.

1,252,586. Electric Switch; Charles J. Klein, Milwaukee, Wis. App. filed Jan. 30, 1915. Snap switch.

1,252,587. Electric Candle and the Like; Charles J. Klein, Milwaukee, Wis. App. filed Nov. 13, 1915. Improvements.

1,252,615. Current Rectifier; Charles J. Quill, San Francisco, Cal. App. filed Sept. 25, 1916. Improvement on mechanical pole changer.